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EVERYTHING PNEUMATIC

Vol. xxii. SEPTEMBER, 1917 No. 9.

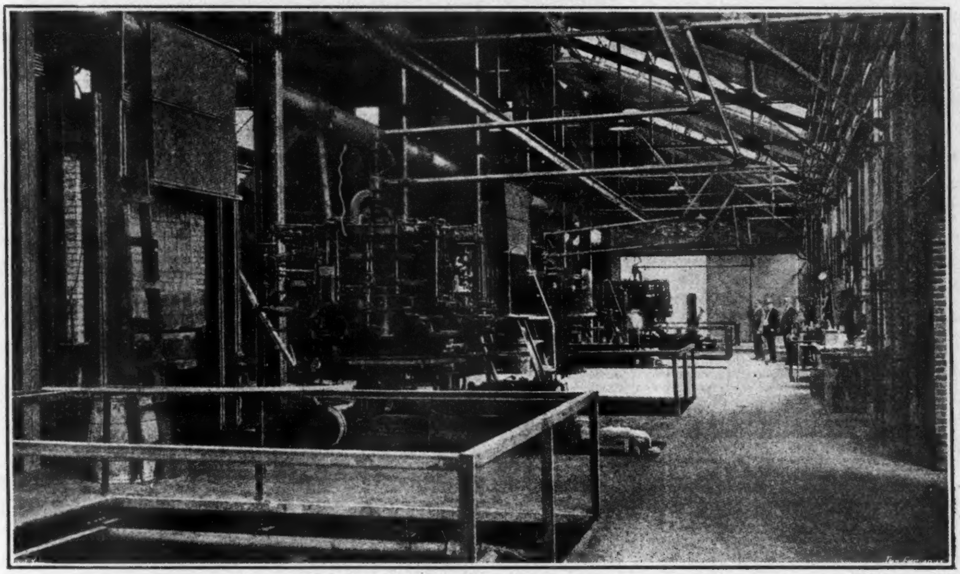


FIG. I. BOTTLE FACTORY SHOWING THREE MACHINES

A MILK BOTTLE FACTORY

It is somewhat remarkable that comparatively so little is known either by the general public or by mechanics and engineers as a class of the practical details of an industry of such far reaching importance as that of glass manufacture. We cannot think of any line of production in which so much specialized ingenuity has been concentrated, and we may say with probable certainty that there is no other line so indebted to the constant services of compressed air for its successful operation.

The present article has to do with a single establishment, and that only one of three, devoted exclusively to the production of a single article, a milk bottle. The plant spoken of is that of the Thatcher Manufacturing Company, Elmira, N. Y., the other two plants spoken of being located at Kane, Pa., and Streator, Illinois. The description which follows, with also the illustrations, is reproduced, with more or less abridgement, from *The Engineer*, London.

In the design and arrangement of the buildings and apparatus, the routine of operations has been carefully planned and provided for, but we here confine our attention to the actual production of the glass and its manipulation—but without hands—to the final delivery of the completed bottle. The raw material, consisting of silica, sand, soda-ash, lime, etc., are delivered from a railroad siding and transferred by conveyors to large storage bins. The materials are taken from the bottom of these bins and elevated to the mixing room on the top floor of the building, from which the progress is downwards to the furnaces.

The method of obtaining the correct mixture is a matter of experiment, and is worked out to suit each particular case. Once determined the correct proportions are maintained automatically. From the mixing room the material is delivered to the furnaces, together with a small amount of cullet (glass scrap). The furnaces are arranged on the floor of the main building. They are built of heat-resisting bricks, and are oblong in shape, being about 7 ft. high and 16 ft. wide. They are divided into a melting pot, refiner, and working pot, the raw material being fed into the melting pot at one end, and after flowing through the refiner, the molten glass is taken through an opening from the working pot at the other end. Producer gas is used in the furnaces. It is of low calorific value, ranging between 140 to 150 B.Th.U. per cubic foot. There are no by-products from the producers. The gas is led through flues to a "butterfly" valve, by means of which it can be directed to a set of burners on either side of the furnace. A similar valve controls the air supply. Root positive pressure blowers are used to furnish the air.

The burnt gases leave the furnace on the side opposite to the burners, passing out through the air supply ports into a regenerator, a large chamber filled with bricks. The burnt gases give up heat to these bricks—which reach a cherry red—and when the flow of air and gas is reversed by means of the "butterfly" valve, this heat is given up to the incoming air before it is mixed with the gas; this, of course, results in a considerable saving. The flow of air and gas is reversed every half hour. The furnaces, owing to the high temperature employed in them, which reaches 2,600 deg. Fah., are comparatively short-lived, the average life of a furnace being 12 to 15 months, and the maximum about 30 months. The working pot, from which the molten glass is taken by the machines, is circular in shape, and is kept constantly revolving, so that a fresh supply of molten glass is continually presented to the machine. These working pots are really a part of the bottle-making machine. They are kept operating continuously as long as the furnace is in service.

The bottle machines are of the Kent-Owen six-arm type. At the time this article was written there were four installed, while two further machines, each with ten arms were in process of erection, and will, by now, possibly be in operation. All these machines represent the latest development in bottle-making machinery. They are *entirely automatic* in operation, and require the services of but one attendant for regulating the speed, inspecting the bottles, and oiling the machine. Fig. 2 shows one of the bottle machines in operation while Fig. 1 gives a general view of the operating floor, showing three bottle machines, the first being run back on its track to give a good view of the working pot.

The entire machine, together with its electrical driving motor, is mounted on a four-wheeled truck, running on rails, so that it can be backed away from the furnace. There are three systems of air piping connected to the machine, one carrying a vacuum of 27 in., to draw the glass into a measuring or gathering mould; one carrying air at 25 lb. per square inch pressure to blow the glass into the forming mould, and one for low pressure air to cool the machine. These pipes can be seen in Fig. 1, the high pressure and vacuum lines on the right, connected to the bottle machines through flexible couplings, and the large low-pressure pipe on the left. The machine as a whole revolves on a central trunnion. That illustrated is known as a six-arm machine—that is, it has six arms, each arm carrying two sets of moulds, a gathering and a forming mould, and it is consequently capable of turning out six bottles for every revolution. The operations are controlled entirely by a set of stationary cams. The main cam raises and lowers the entire machine six times in every revolution. The operation is so timed that each arm, with its gathering mould, dips into the working pot, and, at the same time, is connected to the vacuum line, and a supply of molten glass drawn in. As the machine rises a knife passes under the mould and cuts off the glass. A quarter of a revolution further on the measuring mould folds back, leaving an accurately measured pencil of glass hanging from the end of the arm, as is plainly shown in Fig. 2. Meanwhile, the forming or finishing mould has deposited a finished bottle in the runway, which is also shown in that engraving, and is raised up to the level of the arm, so that it may close around the glass. The air valve then automatically opens, and the glass is blown to the exact shape of the mould. The arm carrying the completed

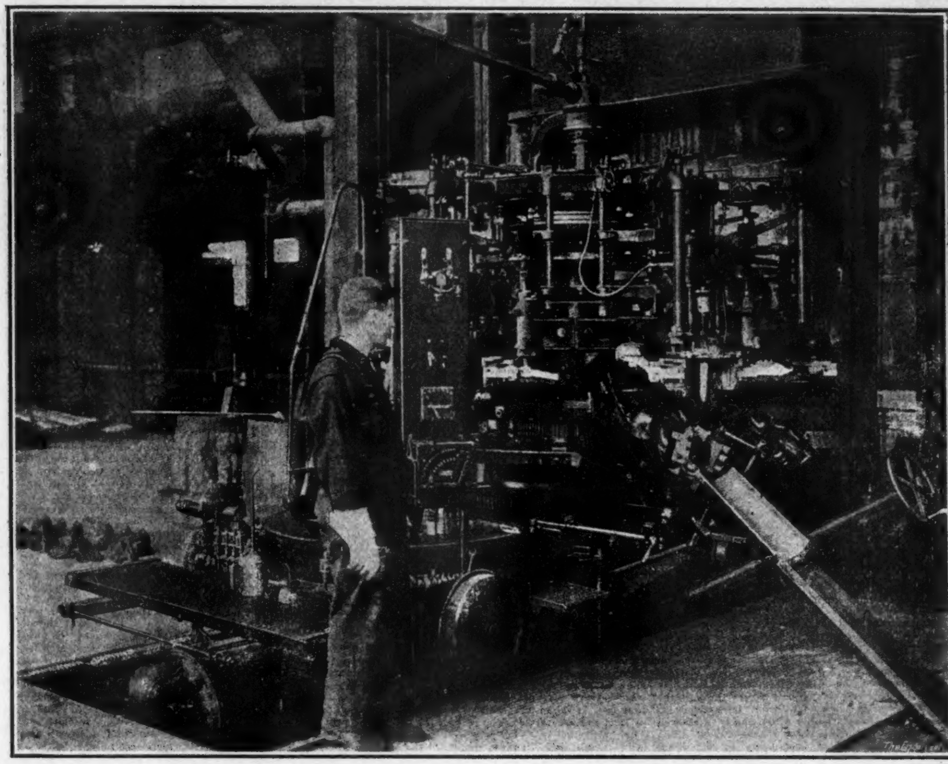


FIG. 2. BOTTLE MACHINE IN OPERATION

bottles is swung down out of the way, the measuring mould again closes ready to receive a fresh supply of glass, and the operation is repeated. With a six-arm machine the above operations are performed six times in every revolution—once for each arm—and, when making one-quart bottles the machine turns out from 12 to 14 per minute.

The bottles are made so rapidly that it is necessary to cool the moulds by blower air to prevent overheating. As the speed of the machine and the heat of the moulds can be regulated to a nicety, a more perfect bottle can be made than would otherwise be possible.

The bottles, on arriving at the end of the runway, while still red hot, are placed in a lehr or annealing furnace, one of which is seen in Fig. 3. These lehrs are 80 ft. long and are equipped every 8 ft. with pyrometers and dampers for regulating the heat. The temperature at the entrance to the lehr is 1,100 deg. Fahr. This is gradually reduced to 90 deg. at the other end. The bottles are placed on an endless travelling grate, which extends across the full width of the lehr. It takes eight hours to reach the end of the lehr, and the bottles are then removed and packed ready for shipment.

The plant is operated by electricity derived from the city mains. An electrically-driven air compressor and vacuum pump of the Ingersoll-Rand Company's "Imperial" type supplies the bottle machine. This compressor is of the duplex "single-unit" type, with cylinders 18 in. in diameter by 14 in. stroke, and is driven by a 75 horse-power General Electric 60-cycle induction motor, through a short belt drive and adjustable idler pulley. The normal speed of the motor is 900 revolutions per minute, and that of the compressor 150 revolutions per minute, which gives a piston displacement for each cylinder of 656 cubic feet per minute. This is sufficient to operate the four six-arm machines now in use, while two new combination vacuum and pressure machines are being installed to work the two new ten-arm bottle machines. The vacuum pump requires no regulation, but the air compressor, being run at constant speed, is provided with an unloader on the intake pipe, which serves to cut off all air from the com-

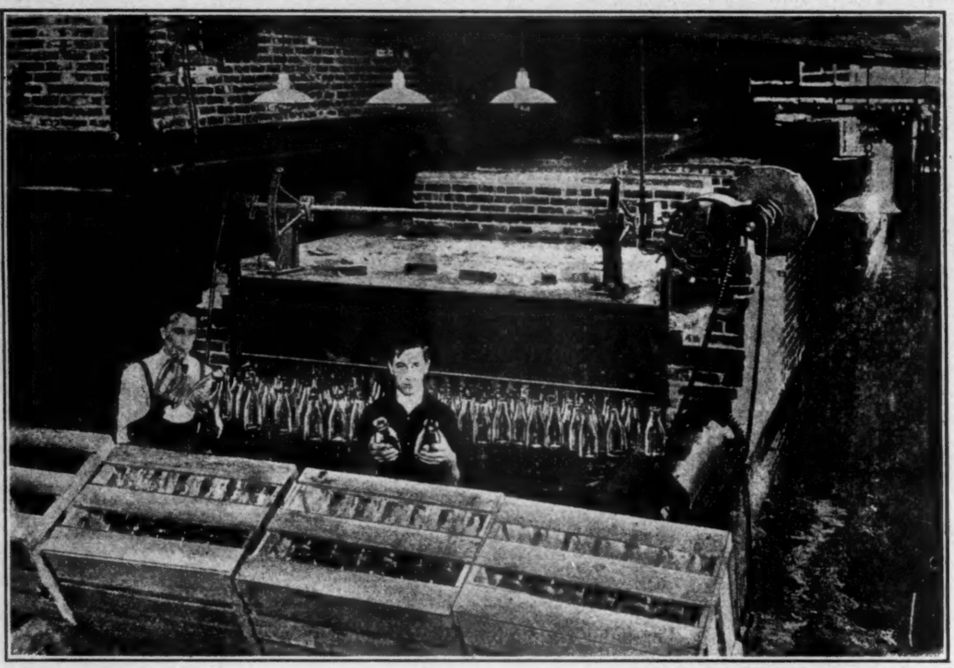


FIG. 3. ANNEALING FURNACE

pressor during unloaded periods. When only two of the three six-arm bottle machines were in actual operation, the compressor was observed to be unloading for a period of about five seconds, every fifteen seconds, as indicated on the chart of a Bristol recording instrument.

The compressor has been operating constantly for a period of three years, carrying the full load of the plant, and is only shut down once a week long enough to remove the outlet valves for cleaning off carbon deposit. This has been the only source of trouble in the machine during that period, and it is due to the great heat of compression. The oil used for the lubrication of both the compressor and vacuum pump is of very high grade, so as to reduce this trouble to a minimum, but a not inconsiderable amount of oil is drawn into the vacuum pump from the bottle machine, which has to be lubricated very copiously with a heavy, low-grade oil on those moving parts which are subject to intense heat. As large a proportion as possible of this oil is removed in a Cochrane oil separator, but it is found impossible to remove it all, and a small amount is drawn into the vacuum pump and finds its way on to the discharge valves.

We are indebted to Mr. R. W. Niven, of the Thatcher Manufacturing Company, for assistance in gathering the data contained in this article.

COMPRESSED AIR FOR ACCELERATING SEWAGE

The city of Bradford, Yorkshire, England, has a main sewer which has furnished a problem of its own for which a complete solution has been found. The sewer is 36 inches in diameter and five miles long with a drop of 70 feet in the distance. The grade of the sewer is not uniform, however, but undulates up and down, in one place curving under a canal, and as the sewage is loaded with heavy solid matter it was found impossible to maintain the flow.

Pumping of course would have been costly and was to be avoided if possible, and it has been found that by using compressed air at a pressure of 80 lb. and discharging it at regular intervals into the sewer, thus forming pistons of air, the full flow of the sewer is maintained with no sign of obstruction. This practice has been followed long enough to demonstrate its complete success, and there is no trouble of any kind.

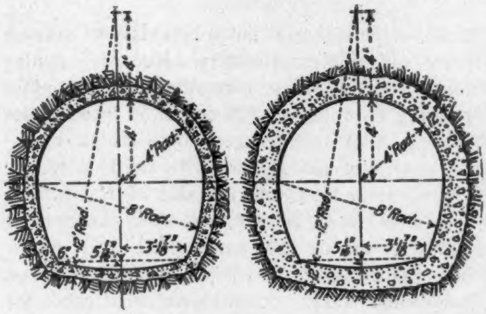


FIG. 1

A TUNNEL DRIVING RECORD AND SOME COMPARISONS

BY H. DEVEREUX*

The Pine Mountain Tunnel which is being driven in Marin county, California, is for the Marin Municipal Water System. It is of horseshoe section, 8 by 8 ft., net, inside the concrete lining. The total length is 8,700 ft., of which about 600 ft. near the two portals will have a 12-in. concrete lining, and the remaining 8,100 ft. 6-in. lining, the two sections being shown in Fig. 1.

The quantities per lineal foot are as follows: Excavations, 3 cu. yd., theoretical amount of concrete in 12-in. lining, 1.2 cu. yd.; concrete in 6-in. lining, 0.6 cu. yd. The actual quantities of concrete will be about 35 per cent. greater, on account of overbreakage. The work is being done under the direction of M. M. O'Shaughnessy, consulting engineer for the district, A. R. Baker, engineer for the district, and C. T. Broughton, resident engineer on the work. The contract was awarded early in December, 1916, to Mc Leran & Peterson, of San Francisco, at $257,400 for the entire work, or $29.70 per lin. ft. for driving and lining the tunnel. Work was commenced in the middle of December. Hand-drills were used until about February 1, machine-drills since that time. The actual cost of driving has been about the same for both methods, but the machine work is much more rapid. Up to May 15 about 2,000 ft. of progress was made on the east end, and 1,000 ft. on the west end. Concreting commenced about June 1. The maximum progress in driving for any one month has been 568 ft. in the east heading, or 19 ft. per day. The average progress since the machine drills were installed has been 13 ft. per day in the east end, and 10 ft. in the west end.

*Condensed from *Western Engineering*.

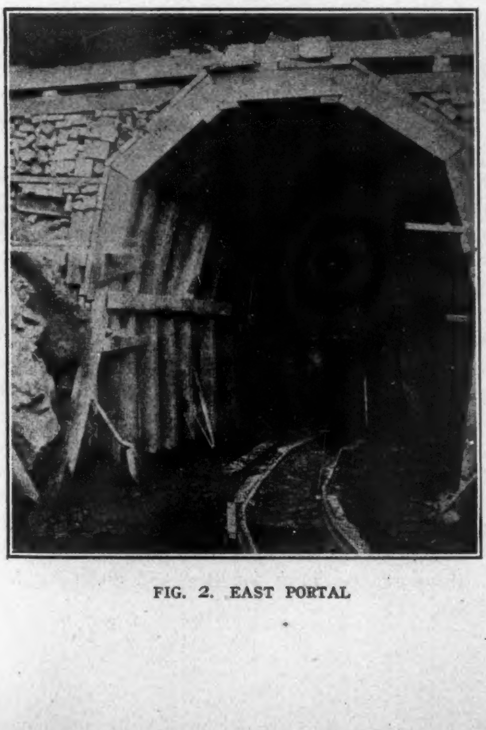


FIG. 2. EAST PORTAL

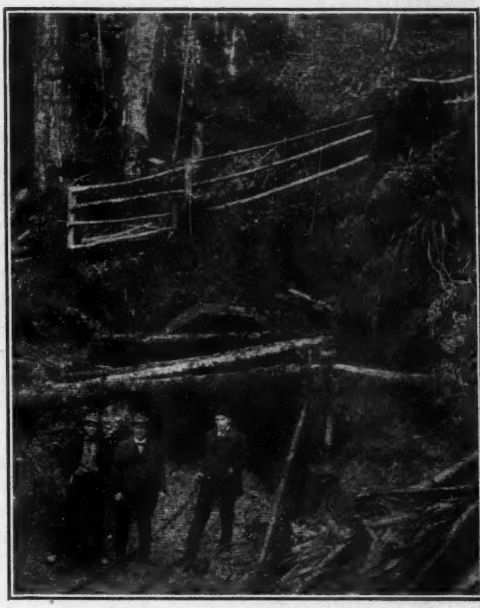


FIG. 3. WEST PORTAL

SOME AMERICAN TUNNEL RECORDS

Some other American tunnel records are as follows:

On the Sheep Creek tunnel in greenstone

and slate the maximum progress was 661 ft. per month and the average for a period of six months, 596 ft. per month. At the Alaska-Gastineau mine, an 8 by 10-ft. tunnel was driven 8,800 ft. at a rate of 544 ft. per month. The maximum monthly progress in the Roosevelt tunnel, which had a 6 by 10-ft. section and was driven in Pikes Peak granite, was 435 ft., and the average was 292 ft. The Elizabeth Lake tunnel on the Los Angeles Aqueduct was driven 604 ft. in one month through black shale. The section was 12 by 13 ft. The Red Rock tunnel, also on the Aqueduct was driven 1,061 ft. in one month through cemented sandstone. An 8 by 8-ft.tunnel for the Arizona Copper Co. was driven 799 ft. in one month through porphyry. The average monthly progress was 669 ft. The Gunnison tunnel, 6 by 10½ ft, was driven 824 ft. in one month through soft limestone. The Mt. Royal tunnel, 8 by 12 ft. was driven 810 ft. in one month through limestone. An 8½ by 9½-ft. tunnel at Mammoth, California, was driven 395 ft. in one month. The average progress was 316 ft. The Laramie-Poudre tunnel, 7½ by 9½ ft., was driven 653 ft. in one month through granite. The average was 525 feet.

The power-plant for the Pine Mountain tunnel is on the Bolinas road about three miles west of Fairfax. The east portal is about 1,000 ft. from the power-house. The west portal is nearly two miles southwest from the power-plant. Until recently the west portal could be reached only by pack-train, but the trail has recently been improved so that light loads can be hauled over the mountain.

The compressor-plant consists of three 25-hp. Fairbanks-Morse Y-type semi-diesel engines, and three 8 by 8-in. Sullivan compressors.

TUNNEL AIR PRESSURES

The pressure maintained at the compressor is 100 lb. per sq. in. A study of records on 25 other long tunnels shows that this is the average pressure maintained. The lowest was 85 lb., on the Strawberry tunnel, and the highest, 120 lb. on the Laramie-Poudre. Six tunnels used 100 pounds.

Air is conveyed through a 3½-in. pipe 1,000 ft. to the east portal and 10,000 ft. to the west portal. Three hundred cubic feet of free air per minute is supplied, which is sufficient to run three drills and also the forges. The loss of pressure at the west end does not exceed 2 lb., which shows the advantage of having pipes of sufficient capacity. Records on nine long tunnels show capacities of air plant ranging from 247 to 868 cu. ft. of free air per minute, with an average of 550 cu. ft.

Three No. 18 Leyner drills with a 1¼-in. chuck, 24-in feed, and six sets of 1¼-in. hollow steel from 24 to 96-in. long were used. There is an 18 gal. motor tank and an air line manifold. The drills are mounted on horizontal bars. Jackhamers are used for trimming. On other long tunnels preference was about equally divided between vertical columns and horizontal bars.

The duty of a No. 18 Leyner drill in this tunnel is 5 ft. of hole per hour, using 1,000 cu. ft. of free air at 100 lb. pressure per lin. ft. of hole drilled. The cost of drilling including bonus, is $0.20 per ft. This estimate allows for delays.

POWER COSTS

The cost of fuel and lubricating oil for a 135 day run was as follows: 11,000 gal. fuel oil, 24 Baumé gravity, at $0.032 per gal. = $352; 250 gal. valvoline, strained and used twice, at $1.35 = $324; hauling three miles from railroad, at $0.005 per gal. = $55; total, $731.

The plant was run continuously and 62½ hp. was developed. This gives a cost of $0.36 per hp. hour for fuel and lubricating oil, the power being sufficient for three drills and two forges. The cost of labor at the power house is $320 per month. During March the total progress in both headings was 854 ft. and the cost for power was $0.65, of which $0.29 was for fuel and $0.36 for labor.

A 25 hp. Fairbanks Morse Y type engine has since been installed to operate a 220 volt, 25 kilowatt generator which will be used to run a lightning plant and a rock crusher.

COSTS OF ELECTRIC POWER

Purchased electric power on four other long tunnels cost from $1.65 to $2.15 per lin. ft., or an average of $1.90. Electric power generated on the work for the Elizabeth Lake tunnel on the Los Angeles Aqueduct, cost $5.25 per ft., and on the Strawberry tunnel, where it was transmitted 23 miles, $5.50 per ft. On another tunnel where steam was used with wood for fuel, the cost for power was $2.50 per ft. Where steam was used with crude oil for fuel the cost was $2.28 for fuel and $0.80 for labor.

VENTILATION

For ventilation 1,000 ft. of 10 in. pipe has been laid at each heading, reducing to 8 in. for the remainder of the distance. This pipe has been found to be too small, and is to be replaced with a 12 in. pipe, using a blower working at a pressure of 4.5 lb. To clear a tunnel of foul air in 15 minutes, which is the maximum time that should be allowed for delays after blasting, requires a capacity of 4,000 cu. ft. of air per minute. An accepted rule is to allow 75 cu. ft. of air per man per minute, and 150 cu. ft. per animal. The average rated capacity of ventilating apparatus used on 16 long tunnels was 3,400 cu. ft. per minute. The size of the ventilating pipe ranged from 10 in. for the Carter and Mission tunnels to 18 in. for the Elizabeth Lake and 19 in. for the Central tunnel. Where light gage sheet metal pipes are used for ventilating, it is advisable to build a small bulkhead of track ties in front of the pipe before blasting in order to prevent collapse of the pipe.

ILLUMINATION

For lighting, acetylene lamps on the men's caps or candles have been used, but, as already noted, an electric lighting plant has now been installed. Acetylene lamps have been used on several long tunnels, small lamps on the men's caps and larger stationary lights placed 150 ft. apart along the tunnel. This is an economical method of lighting. When electric hauling is done electric lights are usually employed. In wet tunnels electric lights are uncertain. The cost of lighting the Mile Rock tunnel with electricity was $0.50 per ft. of tunnel.

THE ROCK AND THE DRILL HOLES

The rock so far encountered in the east end of the tunnel is sedimentary with intrusive igneous rock. On the west end there is Franciscan sandstone, black serpentine, and hard boulders, with some diabase. The rock at the west end is harder than at the east end.

The number of holes per round at the east end is 9 to 14, and 14 to 16 at the west end. Six feet of hole is drilled per round, the wedge-cut system of arrangement being used. Forty per cent. L. F. gelatine powder is used, supplied by the Hercules Powder Company. In the east end, 9 lb. of powder, 19 ft. of fuse, and 4 caps are used per lin. ft. of progress. In the west end, 15 lb. of powder, 26 ft. of fuse and 4 caps are required.

Records of other long tunnels show that the wedge-cut was used in 19 instances, the pyramid-cut in 4, and the bottom cut in 7. An analysis of the depth of holes generally used in American practice, would lead one to in-

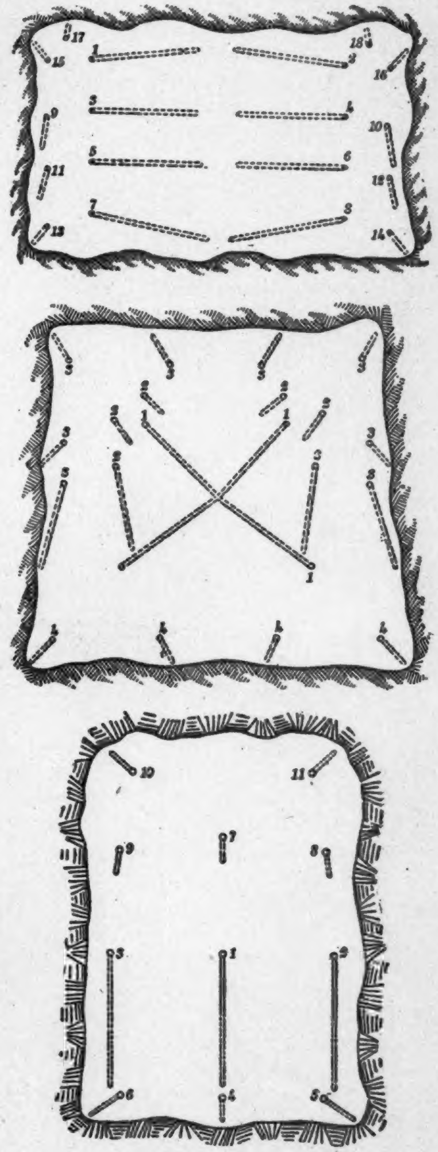


FIG. 4

WEDGE CUT

PYRAMID CUT

BOTTOM CUT

fer that the most successful driving was secured when the average depth of the holes was from 60 to 80 per cent. of the width of the heading for wedge and pyramid cuts, and 60 to 80 per cent. of the height for the bottom cut. In cases where deeper holes had been used, and the depth of holes was later reduced according to the above rule, there was an increase of speed of as much as 20 per cent. and a decrease of powder used of as much as 25 per cent. The number of holes per round is dependent upon the character of the rock. An approximate rule for sedimentary formation is one hole to 5 to 6 sq. ft. of face of heading, and in igneous formations, one hole to 2.5 to 4 sq. ft. of face.

EXPLOSIVES

The amount of explosive used in small tunnels ranges from 3.5 to 10 lb. per cu. yd. of material removed. Bottom-cut holes appear to require more powder than pramid or wedge-cut holes. As regards percentage of gelatine powder used, practice has ranged from 40 per cent. in six tunnels to 100 per cent. in the Roosevelt tunnel, which was driven through Pikes Peak granite. Loading the bottom of the hole with 80 to 100 per cent. powder and the rest with 40 to 60 per cent. has given good results in a number of cases. On the Grapevine division of the Los Angeles Aqueduct 40 and 60 per cent. ammonia powder was used. There was comparatively little difference in the effect of the two grades. Ammonia powders are affected by moisture and are not suited to wet tunnels. The gases from the ammonia are disliked by the workmen.

It is best to place the cap near the top of the charge and tamped with powder, although many powder-men prefer placing the cap at the bottom of the hole. A cap has recently been placed on the market that acts like a time-fuse, enabling the cut-holes, relievers, back-holes, and lifters to be fired at intervals and in rotation by an electric battery.

On the east end there are two drillers and one helper per shift, and one driller and one helper per shift on the west end. Three shifts are worked and as many as five rounds or 30 ft. of progress has been made in 24 hours, requiring 150 ft. of drill-hole per drill for each 24 hours. Four shovelers are employed on a shift in each end, two working at any one time and two resting. They handle from 10 to 15 cu. yd. per man per shift. The shovelers use square-pointed shovels, and shovel from steel floor-plates, ¼ in. by 4 by 6 feet.

The material is transported by mules in turn-table end-dump cars of 25 cu. ft. capacity. When the work has progressed so far that mules cannot handle the material economically, it is proposed to remodel White or Stanley steam-automobiles to do the hauling. Such remodeled machines are now being used successfully on the Twin Peaks tunnel.

WATER IN TUNNEL

Considerable trouble has been experienced at the west end of the Pine Mountain tunnel on account of water. There are "pockets" of water that give a large flow for a few days and then run dry, making pumping a difficult matter. This has been remedied by cutting a ditch to drain the water back from the face of the tunnel. This matter of drainage is frequently a considerable item of expense in long tunnels. The cost of pumping at the Mile Rock tunnel was $1.30 per lin. ft. At the east end of the Strawberry tunnel, the wet end, the cost of pumping was $1.36 per lin. ft. At the Roosevelt tunnel a drainage ditch 4 by 6 ft. was excavated at a cost of $1.10 per ft. If an 8 by 8-in. ditch is carried under the track in the middle of the heading, lined on the sides and covered with a 2-in. plank at an elevation of 18-in. below grade at the same time as the rest of the drilling is done, the water-problem at the lower end of a tunnel will be easily and economically handled. A similar arrangement is advisable at the upper end of the tunnel whenever the grade is such that the ditch need not be over 4 or 5 ft. deep at the portal.

TOO MUCH OF A HURRY

A favorite recommendation in selling a car is that it will pick up speed very rapidly; but it would seem that both dealers and manufacturers are working against their own interests in suggesting such methods of operation to users of cars. To accelerate a car weighing over a ton from five miles an hour to forty miles in fifteen or twenty seconds means a tremendous strain on every portion of the machine, with consequent rapid deterioration, and is especially destructive of tires. Moreover, there is no reasonable advantage in the procedure, for the time gained thereby could hardly be measured with a stop watch in a day's run. The result is attained by supply-

ing a much greater power than the user has any need for, and the principal use made of it is to jump across the track in front of trolley cars and railroad trains. Once a year it might save a man's life, but even then it would not be necessary if ordinary precaution is observed in driving. In the meantime the car owner is paying for a lot of gasoline consumed by the excessively large engine, which has been of no benefit to him.—*Scientific American.*

OLD, OLD SOAP BUBBLES

Prof. J. Dewar, in a discourse recently delivered at the Royal Institution in London, explained how soap bubbles could be made to last for months, and exhibited several specimens. The first requisite is that the air used in blowing the bubble shall be free from dust. In Prof. Dewar's process the air is filtered through cotton wool, and the bubbles are blown by opening a stop-cock in the air-supply tube. For the soap solution he prefers the purest oleic acid (tested by the iodine number) and ammonium soap (not potassium or sodium). To make a bubble durable the sac of liquid must be removed from its bottom by suction through tubes applied from outside. The lecturer showed bubbles more than half a yard in diameter, blown in glass vessels containing pure air at atmospheric pressure. A little water is kept at the bottom of the vessels. A uniform temperature of about 50 degrees Fahr. is favorable to longevity. Some of Prof. Dewar's smaller bubbles were nearly a year old.—*Scientific American.*

BENEFICENT THIEVERY

Dr. Marques da Silva rented a house in a suburb of Rio Janeiro to a family of negroes. After remaining in the house long enough to run up a good-sized unpaid rent bill, the negroes suddenly decamped, taking with them all the electric wiring and plumbing fixtures in the house, and a lead pipe leading underground to a water-main. Dr. da Silva went through the looted house and sat down on the veranda to think over the iniquity of his missing tenants. Suddenly he noticed a peculiar metallic gleam in the trench where the pipe had been torn out. The gleam was caused by mercury oozing from the clay. The mercury mine probably will make the doctor a millionaire.

SCIENTIFIC GUARDIANSHIP OF COMPRESSED AIR WORKERS

BY EDWARD LEVY, M. D.

Physician to the New York Public Service Commission

The use of compressed air in subaqueous work has been common practice during the past 75 years, but, until recently, very little progress has been made in the elimination of compressed air illness among the workmen. This has been a serious deterrent to carrying on work of this character. The present day treatment of compressed air illness probably dates from the time when E. W. Moir, in 1890, introduced the medical lock for decompression, in connection with the construction of the first tunnels under the North River, which, after many mishaps, were completed in 1908.

The sinking of caissons for bridges and building foundations had always been attended with numerous cases of compressed air sickness, oftentimes fatal. The large tunneling projects in the United States and England offered the first general opportunities for the study of large numbers of men employed in this class of work. The period from 1902 to 1908 was marked with great activity in compressed air tunneling in New York City, by the construction of six tunnels under the North River and eight tunnels under the East River.

SOME IMPROVEMENT

While each succeeding large enterprise showed some slight improvement, the results were so far from being satisfactory that it was found necessary by the Department of Labor of the State of New York to formulate certain rules for the protection of the men employed in compressed air.

Probably the best record previous to 1914 was that made during the construction of the Pennsylvania tunnels under the East and North Rivers. The record on the Pennsylvania work was regarded as exceptional, there having been but 3,692 cases of "bends" reported, with only 20 deaths. The latter figure was thought an extremely small number of fatalities for this character of work. The results obtained were due to the great care exercised by those in charge who provided a staff of physicians assisted by nurses trained in the particular work of handling compressed air illness. While it was found that the results of the Pennsylvania work were much

better than had previously been obtained, yet they were not considered satisfactory.

Realizing the unprecedented magnitude of the compressed air tunnel work which was about to be undertaken under the Dual System contracts, the Commission determined at the outset to obtain the best possible working conditions for the men employed in the tunnel headings. To this end, conferences were held with medical experts and the experience of the engineers themselves was utilized. It was recognized by those charged with the carrying out of this work that, in order to prevent as far as possible compressed air illness among the engineers and workmen, there must be enforced the most rigid requirements for the conduct of the work, particularly as to the selection of the men employed, the hours of labor, the methods of decompression and the facilities for the treatment of the men in case of compressed air sickness.

SPECIFICATIONS PREPARED

To this end, specifications were drawn up in accordance with the labor laws, with additional requirements to fit this particular work. It was provided in the specifications that the quarters for the workmen should be fully equipped with proper facilities for bathing, resting, drying the clothing, and for a supply of hot coffee at all times; that the hospital room have an attendant constantly in charge; that a medical lock with two compartments be furnished where the men could be subjected to treatment if attacked by compressed air illness; that this lock should contain cots, a telephone, an air gage; that there should be arrangements for the removal and hospital treatment of any employe who required it; that every person employed in compressed air should be subjected to a rigid medical examination, and employed only if found to be fit to engage in such work; that such employe should be subjected to re-examinations during the course of the work, in order to watch his physical condition, and that all parts of the tunnel should be kept in a thoroughly sanitary condition and free from refuse.

That the conditions attending decompression should be as nearly ideal as practicable, it was required that whenever the air pressure exceeded 22 pounds per square inch there should be an intermediate chamber, so that the men would be required to pass through two air locks; that each lock be provided with an air gage and a clock, so that a record could be kept of the decompression, and a lock tender must be on duty at all times to decompress the men as directed.

In addition, the question of air supply in the tunnel headings was specifically covered in that the contractor was required to cool the air so that the temperature should be moderate at all times; that the supply of fresh air should be sufficient to prevent the accumulation of carbon dioxide to a greater amount than one part in a thousand; and that adequate ventilation should be provided by means of vent pipes carried from each heading under pressure to the outside atmosphere.

SYMPTOMS OF DISEASE

There are several symptoms of compressed air sickness; one, the so-called "bends," another termed "chokes," and still another known as "staggers." In some cases paralysis, and in extremely severe cases collapse and death occur. The symptoms are due to the liberation of bubbles of nitrogen, which, taken up in solution by the fluids of the body while compression is under way, are liberated in various parts of the body when the men are decompressed too rapidly. The amount of gas taken up by the tissues during the compression period would naturally depend on the length of time the subject is under compression, and the pressure. The "bends," most frequent of the several symptoms of caisson disease, is marked by pain in the joints, generally extremely severe. If bubbles lodge in the blood vessels of the lungs a partial obstruction is caused, and the patient suffers from a form of the disease commonly termed "chokes." Vertigo, commonly known as "staggers," is most often caused by air bubbles in the brain, or in the middle ear. Collapse, followed by death, is caused by quantities of free air in the circulation.

The process of decompression consists in bringing the tunnel worker back to normal air pressure by way of the air locks. If this decompression takes place too quickly, symptoms frequently are manifested. The situation has been compared to the opening of a bottle of effervescent wine or water, when, if the cork is suddenly drawn, the bubbles of gas rise quickly to the surface and are liberated with great force. On the other hand, if the cork be drawn carefully, and the latent effer-

vescence be permitted to escape slowly, the liquid will remain undisturbed.

A MEDICAL JOKE

In this connection, an amusing story related by Hill in his book "Caisson Sickness" is of interest. Certain commissioners who went to celebrate the completion of a tunnel took some highly carbonated ginger ale into the compressed air chamber. Owing to the compression, when the cork was drawn the liquid proved flat, and, thinking it bad, all except one refused to partake. The latter, being thirsty, drank half the bottle, which he then corked and put into his pocket. During decompression in the air lock the cork of the bottle blew out with a loud report, causing much excitement, one commissioner believing he had been shot. This was nothing compared with the disturbance caused within the anatomy of the commissioner who had partaken.

At this writing, the air pressure on the Whitehall-Montague street tunnel is 33 pounds while that on the Old Slip-Clark Street tunnel has been reduced to 17 pounds as the tunnel headings have met. Before the meeting of these headings, a maximum pressure of 37½ pounds was reached. The pressure on the 14th Street-eastern caissons which are being sunk in advance of tunneling has reached 39½ pounds, but, eventually, after tunneling has been started, the pressure will probably reach a maximum of 45 pounds. On the 60th Street tunnel work no pressure has been used as yet, but ultimately, it is expected that the pressure on this work may reach 50 pounds, the highest yet used in tunnel work in New York City.

EXPERIMENT SUCCESSFUL

Up to the time that the air pressure had reached 21 pounds, which is a relatively light pressure, the engineers and physicians in charge of the work were not in a position to determine whether the precautions which had been taken to minimize compressed air illness were to prove effectual. But, as the pressure was raised above this point, and no serious results followed, it became fairly certain that the new requirements would prove to be the solution of the problem. Up to the present time there have been more than 700,000 decompressions, and it is believed, from the results thus far obtained, that it is possible to work with safety under a pressure in pounds considerably in excess of the limit now fixed under the New York State labor laws, provided the working shifts and time and method of decompression are properly adjusted.

To date there have been recorded only 304 cases of "bends" during the construction of the new East River tunnels under the supervision of the Commission, over a period of two and a half years of compressed air tunneling. If this record be compared with the records handed down from some of the earlier tunnel projects in New York City, one of which shows 179 reported cases of "bends" in three weeks, it will appear that considerable progress has been made in the elimination of compressed air illness among the workmen. In comparing records of this character, it must be constantly borne in mind that the number of reported cases of "bends" is far below the actual, as the workman, unless he is in such physical pain that he must seek relief, attempts to keep his record clear and conceals his ailment, as repeated cases of "bends" would tend to show him unfit for the work, and might result in his being disqualified, especially under higher pressures. This record is a true record as far as can be obtained from a most careful supervision of the men upon their exit from the tunnel headings, and it is probable that there have been numerous slight attacks which have not been brought to the attention of those in charge. This, however, is no more true of this work than any other work of a similar character.

ONE FATAL CASE

Only one case of compressed air illness on this work has proved fatal, which, in itself, establishes a very remarkable record. In this one instance, the physicians and engineers are confident that the life of the workman undoubtedly could have been saved had he, immediately after leaving the compressed air lock, notified someone in authority that he was ill. His condition was not discovered until an hour and fifty minutes after he had left the lock. Emergency treatment applied at that time was not effective, owing to the destruction of tissue which had taken place during the intervening periods. Investigation of this case developed a question as to whether the man took the full time for decompression as prescribed by the regulations.

THE HOSPITAL LOCK

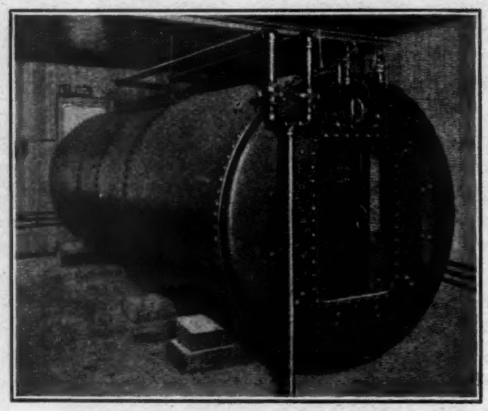
It has been customary, as in other recent work, to treat the man in the hospital lock, as

shown in Fig. 1. This treatment has consisted of recompressing the man to the same pressure as that within the tunnel headings, reducing to the half pressure mark comparatively slowly. Thence on the reduction is very slow until atmospheric pressure is reached. This method has generally proved effective, unless the patient has been out of the tunnel for a long period, when the response to treatment, as a rule is not so ready.

In the opinion of the engineers and physicians on the work, the great freedom from "bends" has been due primarily to the very careful medical treatment examination of the workmen, to the shorter working shifts now enforced and to the rigorous enforcement of the method of decompression. In particular, probably the greatest factor has been the requirement that the men pass through the intermediate chamber when the air pressure has exceeded 22 pounds. This method of decompression is a modified form of stage-decompression. It is recognized as the most effective method of decompression that has been in use.

METHOD IN DETAIL

The intermediate chambers have averaged about 800 feet in length, and it has been customary for the men to come out of the heading through the first lock and into this chamber as rapidly as they desired. But, after walking through the intermediate chamber after the first decompression and entering the second lock, the time required for decompression in this lock has been the full period which would have been required if the men had come directly out of the headings, without the preliminary decompression. In this way the time consumed in decompression has considerably exceeded that prescribed by the New York State labor laws.

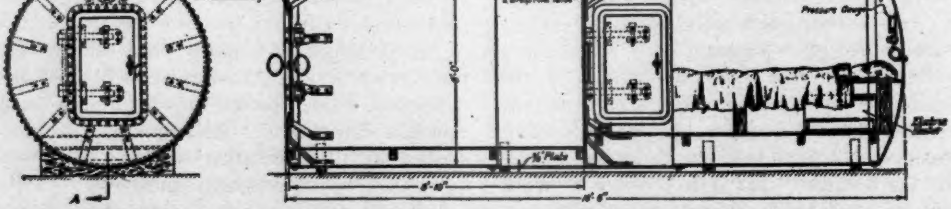


THE MEDICAL LOCK

CARELESSNESS OF THE MEN

The great difficulty in handling men who are working in compressed air is to make them feel that the precautions which are required by those in charge are not mere unnecessary hardships, but are for their benefit. The ordinary workman adopts the attitude that all requirements as to time and manner of decompression are a needless precaution, and are uncalled for obstructions to his exit from the tunnel heading. Consequently a careful watch has to be kept over the men in order to make certain that they do not decompress too quickly, by slipping out through one of the material locks. It has been found necessary to maintain a watchman on duty at each lock to check off each man as he enters and leaves the tunnel heading, thereby obtaining a record of the time taken in decompression. In this way, and in this way only, can proper decompression be insured.

From the experience thus far obtained on the work, it is felt that the dangers of com-



DETAILS OF MEDICAL LOCK

pressed air illness can be largely eliminated in the higher pressures, provided the proper precautions are observed. In this connection the labor laws require that in decompression the air pressure in the lock shall be decreased at the rate of three pounds every two minutes, unless the pressure is over 36 pounds, in which event the decompression shall be at the rate of one pound per minute. In addition, the following requirements are fixed as to the hours of work in each 24 hours under compressed air:

Pressure Above Atmosphere.	Hours in Working Shifts.
0—22	8
22—30	6
30—35	4
35—40	3
40—45	2
45—50	1½

COMPLIANCE WITH THE LAWS

Each of the above shifts is divided as required by law into two parts, with an intervening period outside the tunnel. The length of the rest period varies from one-half hour at the lowest pressure to five hours at the highest pressure. It is apparent that the number of men required to carry on the work with tunnel headings increases very rapidly with the increase in air pressure. It has been found advisable in decompression to have the locks sufficiently large to permit the men as much freedom of movement as possible, as exercise stimulates the circulation and helps to eliminate the nitrogen from the tissues.

CARBONIC ACID DOES NOT COUNT

Regular tests have been made of the air in the tunnel headings in order to determine the amount of CO_2, the temperature and the saturation of the air, but, from observation of the results of these tests, and the number of cases of bends, the physicians are convinced that the amount of carbon dioxide thus far found has no effect on the number of cases of "bends." But the number of cases of "bends" has been found to increase markedly as the air pressure has been increased and the length of the shift remained unchanged.

SHORT SHIFTS FAVORED

Each time the shift has been shortened, although the pressure has been increased, there has been a distinct decrease in the number of cases of "bends" reported. For instance, with 3-hour shifts at 29 pounds, the number of cases of "bends" reported was 93 in 43,000 decompressions, while at 30 pounds with 2-hour shifts, the number of cases of bends reported was only 13 out of 23,000 decompressions, showing that it would not be advisable to increase the number of working hours beyond those now in effect.

FUTURE OUTLOOK

Although the work at the present time is far from completed, and as yet no experience has been had with pressures above 37½ pounds, it seems safe to assume that the record has been all that could be desired; and there seems no reason why it should not be continued under the high air pressures which will be required on the 14th Street and the 60th Street work. Complete records are being kept of all the data which appear to have any bearing on the study of compressed air illness, so that at the completion of this work the information obtained will be available for future tunnel enterprises.

In conclusion, the writer desires to state that this excellent record has been made possible only through the hearty coöperation of the Commission, its engineers and the contractors organizations. In particular he desires to express his appreciation of the invaluable assistance of Commissioner Whitney, who as Secretary, and later as Commissioner, has endeavored in every way to provide for the needs of the work, and also to Tunnel Engineer Clifford M. Holland, who has given much of his time outside the great engineering problems involved, to the study of this feature of the work, with which the writer is connected. From the *Public Service Record*, New York.

SPELLERIZING AS A STEEL TUBE PRESERVATIVE

Thorough investigation has shown that comparatively the greatest corrosion in service occurs to the smaller sizes of pipe on account of the thinness of the metal. The larger sizes are made from heavier plates of more uniform quality so that corrosion does not so seriously affect them.

To overcome the tendency of corrosion in the smaller sizes of steel piping a process in manufacturing has been devised, which is technically known as spellerizing. This pro-

cess consists in subjecting the metal bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom while still hot to the action of smooth faced rolls and repeating the operation, the surface of the metal thus being worked so as to produce a uniformly dense texture better adapted to resist corrosion, especially in the most objectionable form of pitting. The process is quite analogous to the kneading of dough and operates upon the metal all through instead of merely on the surface. The aim is to make the metal uniform and without the spots of varying texture from which pitting results.

As the process is entirely mechanical and does not in any way depend upon the skill of a workman, uniform treatment and results are assured. The process is applicable to the smaller sizes of pipe, say up to 4 inch.

Pipe has been made by this process for ten years in increasing amounts. The official records of the American Iron and Steel Institute show that during this period the percentage used of steel pipes has increased from 74.3 to 87.9 per cent.

Appended are some special experiences as to the use of this process and its effect upon steel pipe in actual service.

H. J. Macintire, Professor of Mechanical Engineering, Washington University, says in Power:

"In the case of ordinary steel pipe, mill scale is always present, and this likewise is electro-negative to the iron. If this scale is evenly distributed, as in Spellerized steel, the self-corrosion on its account will be slight; but if it is segregated, then local electrolysis and pitting of the material will result."

Morgan B. Smith, in the October, 1913, issue of *Ice*, states with reference to the merits of the Spellerizing process:

"Steel pipe, which has been treated in such a manner as to eliminate or at least distribute evenly the mill scale may be joined with wrought iron or cast iron safely as a rule. . . . The same stock without the treatment for mill scale will show a decided tendency to corrode when joined with wrought iron or cast iron. The so-called Spellerized steel fulfills this condition with respect to the scale."

R. B. Duncan, associated with the United Gas Improvement Company of Philadelphia, Pa., in a paper "Installation and Maintenance of Service," read before the Ninth Annual Meeting of the American Gas Insitute, 1914, states:

"The steel industry has been developing a new process which, after several years' time, has given many encouraging results. By this process the steel is treated mechanically and does not in any way depend upon skilled labor, beyond keeping up the machinery involved, hence uniform treatment is assured.

"This new process is a method of treating metal which consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom, while still hot, to the action of smooth faced rolls and repeating the action whereby the surface of the metal is worked so as to produce a uniform dense texture better adapted to resist corrosion, especially in the form of pitting."

The Gas Record, (issue of September 23, 1914, page 222), in commenting on Mr. Duncan's paper in regard to the Spellerizing process, says:

"The consensus of opinion is that modern steel pipe, particularly if Spellerized, is as durable as wrought iron, and is, besides, cheaper, stronger and more ductile and more uniform in composition."

Pipe steel made in 1906 by this roll-knobbling process tested against pipe steel made in 1897 resulted not only in a somewhat greater loss of weight by corrosion of the latter, but a decidedly deeper pitting of the 1897 steel in six months than occurred in the 1906 steel in thirteen months. In comparison with wrought iron it was found that the two materials lost practically the same weight by corrosion yet the steel had the advantage of uniform corrosion since the "wrought iron skelp pitted in seven months much deeper than the steel did in thirteen months." (Prof. H. M. Howe, Am. So. for Testing Materials, 1908).

A. Sang, in a thorough resume of the question, entitled "The Corrosion of Iron and Steel" (McGraw Hill Book Co., New York, 1910), says:

"The carefully acquired experience of the largest manufacturers of tubes in the world, which induced them recently to abandon the manufacture of wrought iron pipe, teaches

that the use of steel in place of iron, at least in the United States, for the special purpose of tubing is to be preferred; the tendency of steel to pit is somewhat less than that of iron and it welds at the joint fully as well."

"There is very little, if any, difference between the corrosion on the wrought iron and the corrosion on the steel pipe. If anything, the wrought iron is pitted a little deeper, i. e., the pitting on the steel pipe is probably more general all over the surface, but the pitting on the wrought iron pipe is deeper in spots that are affected." (Proc. American Gas Institute, Vol. III, 1908, page 274).

"While the corrosion was about the same, there was a *pitting in the iron that we did not find in the steel,* and the steel was corroded more uniformly. From the tests made I know that the steel pipe is better for such conditions." (Supt. of one of the largest bituminous coal operations in the Pittsburgh district).

It is believed sufficient has been mentioned to show that the tendency of the Spellerizing process is to render the surface of pipe uniform and reduce the tendency to corrosion—especially in the form of pitting.

NEW JACKHAMER MOUNTING FOR THIN COAL SEAMS

BY H. L. HICKS

In the search for ways to increase production with a lessened working force there has been developed in the Scranton district a new system of mining the thin seams of anthracite common to that field. Under-cutting these thin seams by machine has been a slow and relatively costly process, and in many instances an impossibility, owing to bad bottom filled with sulphur balls. Hand-mining has nothing to recommend it and is excessively costly.

The new method is entirely one of boring and blasting, based on the use of compressed-air-operated Jackhamers and cruciform coal augers, with a special type of mounting, as shown in Fig. 1. While it is possible to work with Jackhamers without the mounting, its use is of decided advantage in reducing the fatigue caused by working in cramped positions, unavoidable in mining narrow seams.

The Jackhamer is the self-rotating hammer drill which is too well known in the coal-mining industry to need further description. The mounting which makes this new system

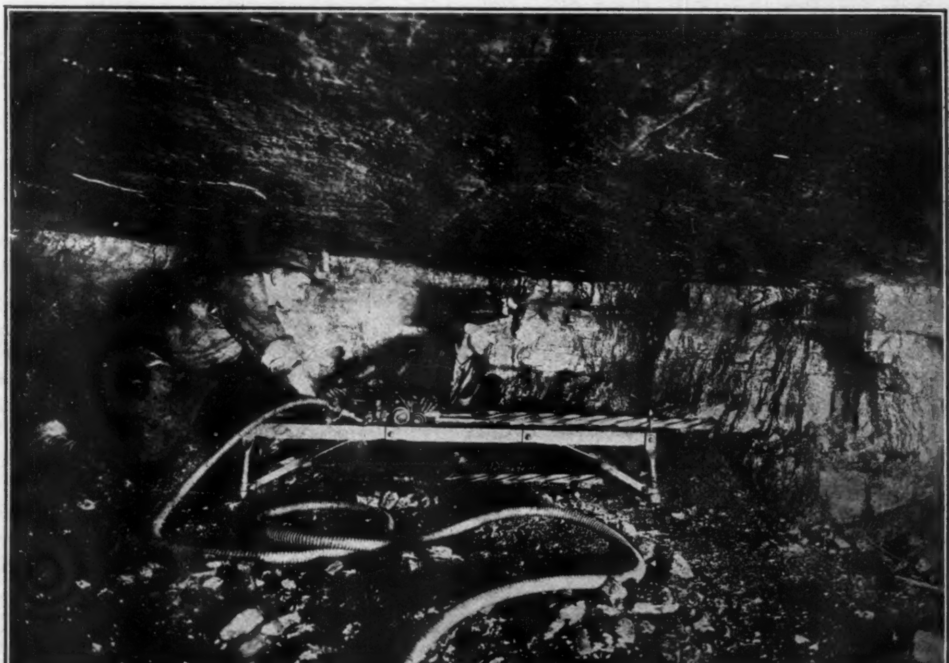


FIG. 1

practicable for narrow seams is simplicity itself—a frame carried on four legs, the principal feature of which is two rails on which the Jackhamer slides, the latter being held in a suitable carriage. Two hinged clamps with swing bolts quickly secure any standard Jackhamer or permit its convenient removal from the carriage, which in turn merely rests on the slide rails. The mounting, which is styled by the manufacturer Type JC-40, weighs 68 lb., the Jackhamer 43 lb. and the carriage, as stated, 20 lb. The working crew of drill runner and helper can easily pick up the entire outfit and shift it about as desired.

The distance from floor to center of drill when mounted is 12 in. Extension points, 12 in. long, give additional height where needed and permit the setting up for either flat or angle holes, as shown in Fig. 2. Hinged clamps at the forward end of the frame guide the auger steel and are of particular value in starting a hole.

A set of two steels 3 and 6 ft. in length is the usual practice, although 4- and 8-ft. steels are needed in special instances. Fig. 3 shows the standard steel, a twisted cruciform of 1⅞-in. diameter fitted with standard ⅞-in. hexagon Jackhamer shank and collar. Crossbits are used, with a gage variation of ⅛ in. between changes. Holes are usually bottomed at 2¼ in. Special dies for the Leyner sharpener insure gage exactness in bitting and resharpening this special auger steel.

In operating this equipment it is customary for both men to feed the drill forward on the mounting. It is noted that the positive rotation cleans the hole perfectly and in high drilling speed. Little dust is made.

The following examples outline the possibilities of this method of anthracite mining combination with the hammer action gives a and are representative of the usual practice. For this detail information the writer is indebted to William Wilhelm, of Scranton, Pennsylvania.

Fig. 4. represents a system of drilling a chamber 30 ft. wide where the coal is made up as follows: Top bony 2 in. thick, top coal 6 in. thick, sulphur and bony 4 in. thick and bottom coal 36 in. thick. The chamber is drilled with 12 holes. Eight are drilled in the top measure and four in the bottom. As will be noticed, the top holes are drilled

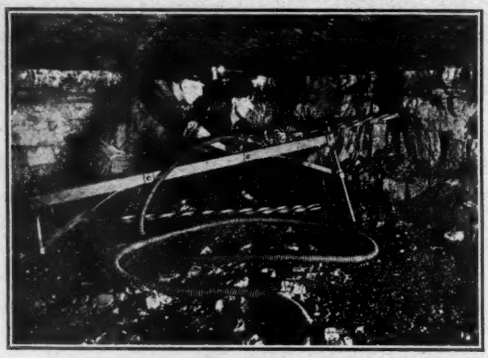


FIG. 2

on an incline toward the bottom, as shown. Hole No. 1 is 8 ft. deep, hole No. 7 is 7 ft. deep, and all others 6 ft. All holes bottom at 2¼ in. and are loaded with black powder as follows: No. 1 with 34 in., No. 2 with 18 to 20 in. and all others with 22 in. Great care is taken in tamping these holes; the tamping, with the exception of the opening hole, should always equal at least twice the amount of powder in each hole.

For igniting and blasting it is found advisable to use an electric squib in the center of the charge rather than a miner's squib or safety fuse. When igniting the near end of a charge of blasting powder in a long borehole it is quite likely that a portion of the coal or rock will move out before the entire charge explodes and relieve the confinement of the powder in the far end of the hole where the burden is usually the heaviest and the greatest explosive force needed. The use of the electric squib requires 6 in. less powder than is possible with miner's squibs, and is safer and more economical, in that it permits the firing of four holes at a time if desired.

Holes are fired in rapid succession as follows: First No. 1, then No. 2, then Nos. 3 and 4, then Nos. 5 and 6 and the remaining holes in pairs. This layout requires 1¼ kegs of powder and will bring down approximately 26 tons of coal when the coal lays as shown.

The total drilling time for this 30-ft. chamber is from 45 to 50 min. for a drill runner and helper using a Jackhamer in the special mounting, giving a drilling speed of 1½ ft. per min. of the total time. With air pressure from 80 to 90 lb. the two men can easily drill six chambers in a working day of 8 hours.

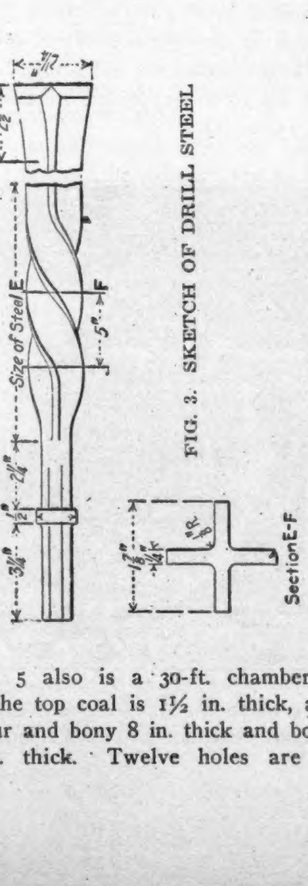


FIG. 3. SKETCH OF DRILL STEEL

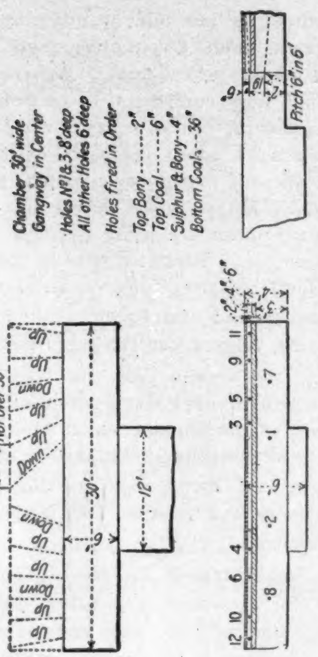


FIG. 4. LOCATION OF HOLES WITH GANGWAY IN CENTER WHEN TWO 8-FT. HOLES ARE USED

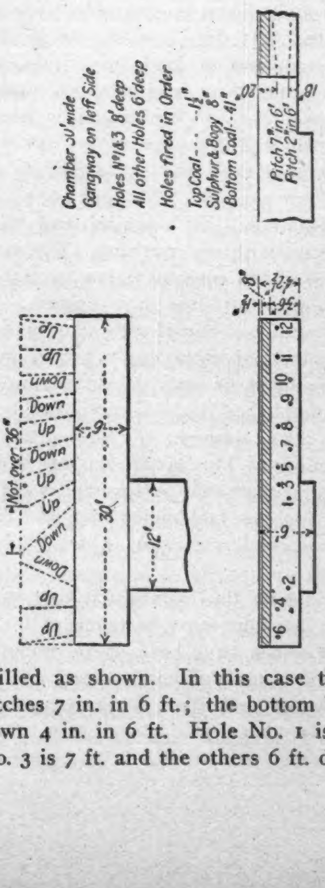


FIG. 5. METHOD OF LOCATING HOLES WITH GANGWAY ON SIDE OF CHAMBER

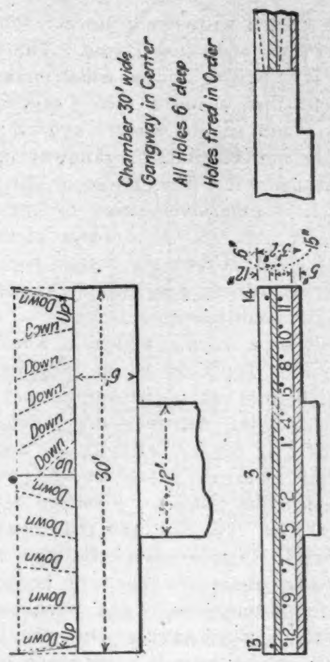


FIG. 6. METHOD OF LOCATING HOLES WITH GANGWAY IN CENTER OF CHAMBER

Fig. 5 also is a 30-ft. chamber. In this case the top coal is 1½ in. thick, a band of sulphur and bony 8 in. thick and bottom coal 31 in. thick. Twelve holes are required, drilled as shown. In this case the top hole pitches 7 in. in 6 ft.; the bottom hole pitches down 4 in. in 6 ft. Hole No. 1 is 8 ft. deep, No. 3 is 7 ft. and the others 6 ft. deep. These

holes are loaded with black powder substantially as in the preceding layout. The order of firing is: Nos. 1 and 2, which make the opening cut, then 3 and 4, then 5 and 6, and then 7, 8, 9 and 10, and last 11 and 12.

It will be noticed that the gangway in this case is at the left. The object of this system, which is extensively used by the Delaware & Hudson Co., is to leave plenty of room on the side to gob the bottom rock and also leave an air opening from chamber to chamber for ventilation.

Fig. 6 shows a 30-ft. chamber in which the formation is: Top coal 12 in., sulphur and bony 6 in., bottom coal 15 in. and bottom rock and bad coal 5 in. All holes are driled 6 ft. deep. No. 1 is loaded with 24 in. and all others with from 18 to 22 in. of powder. These are fired as follows: First No. 1, then No. 2, next Nos. 3 and 4, and the remaining holes in pairs. In many cases the three holes shown drilled above the band of bony and slate are found unnecessary and are not used.

One of the marked savings with the Jackhamer method of mining is a reduction in the cost of loading the coal. By shooting, the coal is brought down in desirable sizes and it is estimated that five cars can be loaded in the time required to load three cars where the coal is undercut and dropped down.

The Jackhamer and coal auger is found to be practical in every case regardless of top roof or bottom rock and is claimed to bring down all the coal in convenient sizes. It is said to eliminate the plugging and barring out necessary with undercutting. The marked advantages of the equipment are its lightness and portability and the low upkeep. It is estimated that an outfit with two men will take the place of from eight to ten miners drilling by hand or will do three times the work accomplished by an equal number of men with other methods of undercutting and machine mining. This latter estimate is based on average observed performances of six chambers for the Jackhamer and two chambers for an undercutter in a working day of 8 hours.

In considering the installation cost of this equipment, account must be taken of the fact that many mines have been using unmounted Jackhamers instead of hand augers for their shothole work and that in these cases the proposition is but one of adapting existing equipment, with a possible slight increase in the number of machines. Where the purchase of new equipment is contemplated it is apparent the initial outlay for a Jackhamer outfit is very small compared with that of other types of machinery of equal producing capacity. Many mines have air available and many more are using portable mine-car compressors. Electrically equipped mines often find the latter form of air power more economical and convenient than permanent air piping from a central compressor.

While the system calls for approximately $1.20 worth of explosives per 30-ft. chamber in excess of the amount which would be used if the coal were undercut, this is more than offset by the increase in speed, saving in maintenance and repairs, and lessened overhead expense.

The Jackhamers in use are extensively employed for rockwork and rather than being an inconvenience, the new type of mounting shown in Fig. 7 is of advantage for this work. Long points or legs can be readily provided and a steel guiding clamp of proper size added at the opposite end of the mounting. By reversing the mounting, roof rock or slate can then be drilled as conveniently as coal.—*Coal Age.*

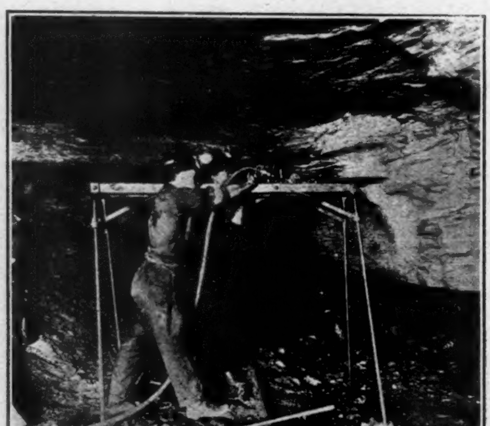
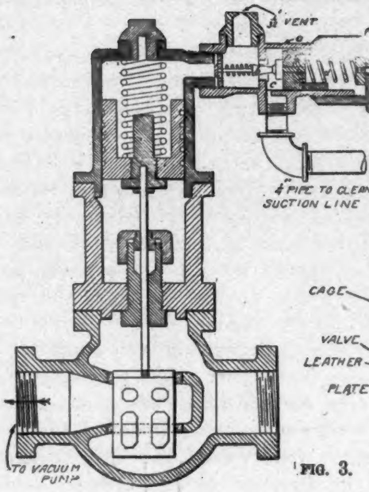


FIG. 7



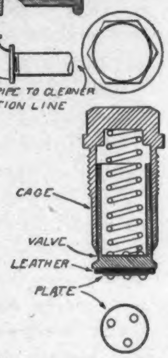


FIG. 3. VACUUM PUMP VALVE

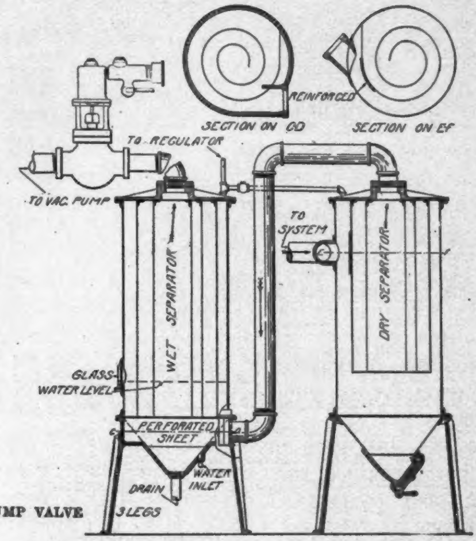


FIG. 1. VACUUM REGULATOR

FIG. 2. SEPARATORS USED IN VACUUM CLEANING SYSTEM

VACUUM CLEANER EXPERIENCES

BY J. C. HAWKINS

Nearly every large office building, department store, hotel or large apartment house of today finds the vacuum cleaner indispensible, the equipment used being a complete system of piping throughout the building with the vacuum pump and appurtenances located where most convenient.

The principal trouble that we have experienced has been the maintenance of the proper vacuum, discharge valve trouble and the clogging up of the hose with objects picked up in cleaning. The machine is horizontal with cylinder 19-in. diameter by 12-in. stroke, driven at a constant speed of 150 r.p.m. by a 25-hp. compound motor through a 5-in. link belt chain drive. The suction header in the basement extends to all parts of the building, from which risers are taken to the several floors with convenient outlets to which a suction hose may be attached. Different kinds of fabrics require different kinds of tools and different vacuums to do the best work, and there may also be considerable loss in the line due to air leakage into the system.

In this plant it is customary to carry from 10 to 12 in. vacuum at the pump for light fabrics and fine work and 16 to 18 in. and sometimes more for heavy work, such as thick rugs, etc., which may be cut down at the tool if desired. With the machine running at a constant speed, the vacuum will vary over a wide range, depending on the use of the tool, unless some system of regulation is used.

Figure 1 shows the vacuum regulator. This is placed on the suction line between the separating tanks and vacuum pump. It consists of a 5-in. balanced valve having an extended stem to which is connected a piston working in a cylinder above the valve. This piston is a neat fit and is grooved to prevent air leakage, but has no rings. A spring above the piston assists gravity in keeping the valve open under normal conditions. Connected to the cylinder above the piston is a pilot valve which allows the vacuum to open or close the main valve, depending on the vacuum in the line. Referring to Fig. 1, this consists of the small cylinder, a, in which there is a piston connected to the threaded cap by a spring. There is also a small valve, b, usually held closed by a light spring assisted by atmospheric pressure. The ¼-in. pipe connects the end of the cylinder, c, to the suction line on the system side of the regulator and operates it in the following manner: With the vacuum pump running and regulating valve open, a vacuum is formed in the system and in chamber c of the regulator which, with the assistance of air pressure on the back of it. holds the pilot valve closed. The piston, p, is under tension of the vacuum with atmospheric back of it, but is held away from the valve by spring d in tension until the vacuum becomes strong enough

to overcome the resistance of the spring and draws the piston against the pilot valve opening it. This places the chamber above the main piston in communication with the vacuum and the piston is drawn up, closing the main valve until the vacuum decreases to the point where spring d overbalances the vacuum and allows the pilot valve to close. Air entering the vent breaks the vacuum above the main piston. The vacuum may be regulated by screwing the cap carrying the spring and piston on, which decreases the tension required to draw it against the pilot valve; or to increase the vacuum, screw the cap off a few turns.

The dirt-laden air, before passing through the regulating valve and pump, must pass through a separator, shown in Fig. 2, consisting of two similar tanks 30 in. in diameter by 60 in. long having spiral plates nearly the full length. The air and dirt enter the dry separator near the top and pass around the spiral to the bottom, at which time the heavier particles of dirt are thrown out by centrifugal force, the air passing up through the center to the wet separator which it enters at the bottom and passes up through the body of water. It then passes up around the spiral, which throws out any entrained moisture by centrifugal force, and the air passes through the regulating valve to the pump.

Although the separator removes the greater part of dirt, a thin coating of scale and dirt will collect on the balanced valve, causing it to stick and prevent the regulator from working. Trouble has also been experienced from dirt collecting on the pilot valve and piston, putting the regulator out of commission. This makes it necessary to remove the parts of the regulator at intervals and clean them with coal oil or gasoline. We find that better operating results may be obtained if no oil is used on the pistons, or very little light oil, for the reason that it becomes gummy, collects dirt and causes the parts to stick.

The degree of vacuum obtained is read on a mercury column attached to the side of the dry separator on the system side of the regulator.

All turns in the suction piping system should be long radius to prevent rags, waste, string and other large objects from becoming caught in the bends; when this does happen, it is necessary either to blow back through the pipe with air pressure or fish the obstruction out with a steel fish wire.

The suction valves in the pump are of the Corliss type operated from the crank shaft through a reach rod. The discharge valves, five on each end, are of the spring-loaded poppet type working in cages as shown in Fig. 3. These valves are faced with leather for quiet operation, as they seat with a slam, and unless these leather seats are kept in good order the valves will either leak or become very noisy. These seats are riveted on with iron rivets to prevent their coming off.

At one time, we had no iron rivets of the proper size and copper rivets were used. After running the machine a few days, a heavy knock developed in the cylinder at the crank end center. The piston has little clearance and an examination of the cylinder with a small electric lamp dropped through the discharge valve opening disclosed the fact that the plate holding the leather on the valve which was riveted on with copper rivets had come off and dropped into the cylinder. It was fished out through the valve opening and no damage done.

The motor drives through a chain belt 5 in. wide from an 8-in. pinion on the motor to a 36-in. pulley on the pump, the distance between shaft centers being 42 in. The chain runs noiseless and is enclosed to prevent accidental catching of clothing. A mixture of flake graphite and engine oil is used as a lubricant and is applied to the working surface of the chain while running. The machine has been in operation intermittently for six years, and aside from minor troubles has given good service.—*Practical Engineer.*

AIRPLANE AND AVIATOR DEVELOPMENTS

The following is compiled by Mr. Fred. H. Colvin, recently Washington editor of *American Machinist,* being based upon the the experiences of British and French fliers as voiced by Wing Commander I. W. Seddon of the British Flying Corps, and Lieut Lagrange of the French Air Service.

THE AIR PROBLEM

The great air problem seems to be to get an overwhelming number of fast, single-seater, fighting machines so as to clear the air of enemy fighters. This not only enables you to take your own observations in safety, but

to keep enemy observers away from your lines, to prevent bombers from attacking, and at the same time to allow your bombing machines to attack at will. This, however, is not considered to be an efficient mode of fighting, unless you can send huge squadrons of bombing machines that can completely wipe out a fortification or destroy bases or troops massed for attack. The present practice in the fast fighting machine is to have 1 hp. for every 10 or 12 lb. weight of machine, with the tendency to increase the power so as to give a horsepower for 8 lb. of machine. This means from 130 to 150 hp. for a small fighting machine.

AIRPLANE TESTS

The French engine tests for a motor of new design consist of a 50-hour run, divided over 5 days. There is a 5-hour run in the morning and a similar run in the afternoon. The first half-hour of each run is at full load and the remainder at 90 per cent. load, as this is all a motor delivers at 6,000 ft.altitude, the power decreasing as the machine ascends. New motors of accepted design are run for 3 hours, pulled down and examined, reassembled and run 20 min. They are then ready for service.

ALTITUDE CONDITIONS

The difference in temperature at different altitudes is a problem peculiar to the airplane motor. The low temperature of a high altitude cools the motor excessively at times, and this is particularly bad when diving from above to catch an enemy beneath. As the motor is shut off to dive, the water cools still more, in spite of the decreasing altitude; and when you throw on power again at the new fighting level, you have a cold motor that is not lively and will not develop the power you would like at that particular moment.

HIGHER SPEED MOTORS

It seemed to be the opinion of both the aviators that a higher-speed motor will be developed for the air service—not under 2,000 and probably 2,500 r.p.m. There are of course several which now reach the lower figure, but the majority are below that. This statement was taken to mean that there is a great probability of the cast-iron cylinder coming back, as it possesses better qualities for high-speed work than the steel cylinders that are being used on account of lightness. The motors must be in the neighborhood of 2 lb. per hp., some being even a trifle under that at the present time. The main thing at the present time, however, is to build all we can of the very best motor we know of and at the same time to make all the improvements possible.

SPECIAL AIRPLANE MECHANICS

The matter of ariplane mechanics is important, and it opens up a new and wonderfully interesting field for many shopmen who can do good work and particularly who know internal-combustion motors; for this is a war of internal-combustion motors in every important field of activity. We shall need thousands of good mechanics in the field as well as in the shop, and it presents an opportunity to many to do their bit in the way in which they can be of the greatest service. The first requirement is extreme care and conscientious work; for there can be no slighting in work of this kind, where not only the man's life, but the service he can render to his army depends on it. For this reason each flier has his mechanicians, generally two, who look after his machines and no others. This arrangement establishes a personal relationship between the flier and his men, which insures extra care and a quality of work that would be almost impossible under a "pooling" system, which may work out well enough on railroads and in similar places. The personal touch counts tremendously here and is taken full advantage of by the flying corps at the front. Every mechanic feels a personal interest in and responsibility for the flier to whom he is attached and is just as proud of his achievements as though they were his own.

HOW TO BE OF SERVICE

Every mechanic who wishes to be of direct service in this line should immediately begin to study the details of airplane construction, particularly of airplane motors, and also get in his application to the air corps of either the army or the navy, as he prefers. There will of course be many more opportunities in the army, at least in the beginning, and this service comes under the Signal Corps, which has divisional headquarters in various sections of the country.

STANDARDIZING

The Aircraft Production Board is hard at work on its project for a huge ouput of airplanes, as has been mentioned before. The situation appears to be nearing the point where there will be interesting developments to re-

late. Arrangements for large production promise to be announced in the near future, as well as the standardizing of a motor that can be built, or rather manufactured, in large quantities and at a minimum cost. It has been developed along novel lines and gives promise of being the latest word in airplane-motor design and manufacture. It is understood that a standard cylinder has been adopted and that this will be combined in groups of four, six, eight or twelve, according to the amount of power desired. The cylinders will of course be interchangeable, developing possibly 25 hp. each, the motors ranging from 100 to 300 hp., according to the plane in which they are to be used.

A large number of training machines are under way, and the different training camps are constantly growing. The final training is likely to be done in France under the same weather conditions as will be encountered in fighting, the field at Avord being suggested for the bulk of this work. This is said to be an excellent field and to have a capacity sufficient for handling thousands of men. It is a city by itself, with workshops for repairs; and in this department it is said Chinese workmen have been giving an excellent account of themselvse.

This is one of the ways in which we can help also, by recruiting the working force from our shops in which similar work is handled, such as the better grade of automobile shops. Many of the French airplane shops are said to be undermanned, owing in a measure to the early mistakes of not exempting skilled mechanics in this line of work. A force of high-grade mechanics sent to France to assist in airplane work would not only greatly increase the production of machines, but would become thoroughly familiar with the methods of the French factories in this work and be of great assistance in this country in later developments of the air machines.

MAKING AIR PILOTS

It takes a special type of man to make a high-grade air pilot, and very severe tests are imposed in selecting the men for this work. Some of these tests seem unnecessarily severe and not calculated to get the right kind of men. But this will straighten itself out in time. The cost of training a first-class aviator is estimated at $4,000, which does not include the damage to machines. This item has, however, been greatly reduced by care and system and is now said to be less than 1 per cent. of the training machines.

All preliminary training is done in machines having a double control, so that an experienced pilot can be with the student to give him confidence and to assume control in case of necessity. After the student becomes expert enough to fly alone, he can use single-control machines that have been returned from the front as showing signs of wear and not being quite up to the mark for fighting machines.

WHERE TO APPLY

For the information of those who are interested in the flying corps, or "winged cavalry" as General Squires calls it, examination boards have been appointed at the following places in addition to the boards already located at the older flying stations: Urbana, Ill., Austin, Tex., Columbus, Ohio, Boston, Mass., Ithaca, N. Y., and Berkeley, Cal.

THE MOUNTAINS SUSTAINED BY FLOTATION.

The United States Coast and Geodetic Survey has determined that the crust of the earth on which the great mountain ranges stand is really lighter than other portions of the earth's surface. The mountains (at least in the United States) are not held up above the level of the sea by the rigidity or strength of the earth's materials but they are held in place by the fact that underneath them the materials (in the outer portion of the earth) are lighter than normal. The higher the mountain or the plateau, the lighter is the material under it. The principle is exactly the same as that involved in the floating of an iceberg in the ocean. The portion of the iceberg which is visible above the water is held up by the large mass of ice, with a density lower than that of water, in the submerged portion of the berg. So, in the case of the mountain mass, the portion above the sea level is held up by the lighter material under the mountain, which extends down to a depth of say, 60 miles. While the mountain is held up or floated by a lighter material under it, the bottom of the ocean is depressed because the material under it to a similar depth below sea level is heavier than normal.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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NO COMPRESSED AIR MISSIONARY NEEDED

It will be remembered that in our issue for May, 1917, page 8367, we reproduced two air pressure record discs from a pressure gage at a Scottish colliery. Our avowed purpose in reproducing the records was to call attention to the low pressure used and to suggest that pressures much higher would have been better practice. It appears that in this case we were more wrong than right all the way through, as the following letter shows. It is thought that no further explanation is necessary:

Editor Compressed Air Magazine.

Sir:—The critical note in your May issue referring to Compressed Air Pressure Diagrams from Chapel Coal Co. is based on complete misapprehension of the conditions of the Compressed Air service there.

The writer of the note misses the point illustrated by the diagrams, viz.: That the Compressing Plant which was too small for the Coalcutters when these Machines were operated without reference to each other, was amply large enough for the required daily output of coal when the working of the machines was suitably arranged according to time table. The time table involved no disadvantage in relation to the working of the pit, and the simple device obviated any necessity for addition to the compressing plant.

It is true that automatic control of the air pressure might have been fitted, but the diagram shows that under the conditions, hand control is quite effective, and that without involving any additional labor or other cost. (On general grounds it is unsafe to say of an even admittedly inefficient colliery plant that it ought to be scrapped and replaced, because the period of prospective life of the colliery is an important factor in the problem).

"The absurdly low pressure apparently regarded as satisfactory" is in fact the pressure most suitable to the conditions, and absurdity lies in the suggestion that it should be increased.

If the Coalcutters in use had been of the percussive type criticism of the low air pressure would be valid, but the machines are of the Longwall type, in relation to which air at comparatively low pressure is much to be preferred on the ground of efficiency. The Coal-

cutters are designed to work at 30 to 35 lbs. pressure, and increase of pressure would simply result in:

(a) Waste of power in compressing.

(b) Increased proportion of loss from pipe line leakages.

(c) Waste of power by exhausting at higher pressure from the Coalcutter.

In Longwall Coalcutters weight is a positive advantage, and there is therefore no difficulty in making cylinders of diameter suitable to give the required power at low pressure. To increase the pressure under these circumstances would be to reduce efficiency. A number of careful tests of the ratio of square yards undercut by machines per shift, to the brake horse power hours delivered to compressors per shift, in connection with Coalcutting Plant at a considerable number of collieries, have proved the superior economy of comparatively low air pressure for this particular service; higher pressures where installed have later been reduced, with marked improvement in economy.

MAVOR & COULSON, Limited.
SAM. MAVOR,
Managing Director.

47 Broad street,
Mile-End, Glasgow.
July 6, 1917.

PNEUMATIC DISPATCH TUBES IN A FREIGHT YARD

The great length of the modern classification yard introduces a serious problem for the operating force through the difficulty encountered in securing adequate communication between the several parts of these large terminals. Telephones supply the necessary facilities for oral communication but the delivery of way bills and other papers from incoming trains to the main yard office, usually located at the hump, and from the main office to the conductors of departing trains, has been a source of great inconvenience and no small delay. As ordinarily administered conductors must either deliver or call for these bills at the hump office or they are carried by messengers, either method offering opportunities for serious loss of time, particularly if one or more bills are found missing when a train is ready to leave. Delays from this cause can easily amount to 30 minutes or more in each case.

The employment of messengers for this purpose and the delays incident to messenger service have been done away with at the Gibson yard of the Indiana Harbor Belt and the Clearing yard of the Belt Railway of Chicago, by the use of pneumatic tubes connecting the general offices, situated at the hump, with the offices at each end of the yard. At the Gibson yard the installation consists of lines of 3-in. steel tubing, running 4,350 ft. west and 4,650 ft. east of the hump, laid 3 ft. to 4 ft. underground. These tubes are open at both ends. In sending, a carrier is inserted in the terminal, the flapper is closed, and air is admitted behind the carrier by pressing a button, which actuates an automatic control device by means of which the air is delivered from a low pressure storage tank for a predetermined period sufficient to insure the arrival of the carrier at the other end of the tube. This air is supplied to the storage tank from the regular railroad service, having a pressure of 90 lb. to 110 lb. per sq. in. at the compressor. There are three cylindrical tanks, one at each sending point, that is, at the hump office and at the east and west yard offices.

At Clearing the tubes are 4 in. diameter and besides the two main lines, short leads connect with the office of the hump yard master and the switching tower at the hump. As these tubes will deliver a package a distance of about a mile in two minutes there is an obvious saving of time over any form of messenger service. At the Clearing yard this saving is estimated at 10 engine hours a day. That is to say, there is a saving of that amount in the time of the engine and train crews—say five men; and there is a potential saving of the per diem cost of the cars in the trains, the movement of which is expedited.

At the Gibson plant the maintenance expenses average $5.97 for three months' time, a figure which is said to be higher than normal. The carriers are handled by the regular clerk so that the expense to be charged for attendance is small. At Gibson the total number of carriers transmitted in a period of 24 hours recently was 220.

The tubes described were installed by the Lamson Company, Boston, Mass. The manufacturer is now recommending the use of motor driven cycloidal blowers at each terminal, so arranged that they run only when

a carrier is in the line. This system is said to operate with a much smaller power consumption than in the case where the air is taken from the regular yard air service.—*Railway Age Gazette.*

REFRIGERATION FOR RIPENING FRUIT

As paradoxical as it appears, in several cases recently we have seen refrigeration used to force the ripening of bananas, says the *Fruit Dispatch.*

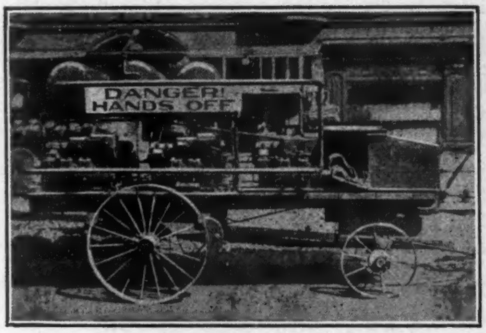
The bananas in insulated rooms were subjected to high temperature for a few hours, say 78 deg. for eight or ten hours; then the heat was turned off and after a short time cold air turned in, gradually cooling the rooms to a settled temperature of 60 to 62 degrees.

Checking the heat in the skin while the interior pulp is still warm and undergoing the ripening process appears to bring quickly a golden color, and the low temperature renders the fruit firm, even if there has been a tendency to soften it by excessive heat.

A RESUSCITATION CHART

The Bureau of Mines, Department of the Interior, Washington, D. C., has just issued a chart on the subject of resuscitation from gas asphyxiation, drowning, and electric shock. This chart is suitable for posting at the mines, in police and fire stations, bathing houses, and all industrial establishments in which there is danger from gas asphyxiation, drowning, or electric shock. It shows the Schaefer, or prone, pressure method of artificial respiration, which is the latest and most approved method advocated by eminent physiologists of the country. The bureau is issuing this chart in the hope of inducing the adoption of this standard method of resuscitation throughout the country, and with the hope that the instructions presented on the chart may result in the saving of human life. Copies of this chart will be sent free of charge to all persons requesting it as long as the edition remains in stock.

Great Britain has about 5 per cent. as many motor cars as this country has, or 171,607. New York, Ohio, Pennsylvania, Illinois, Caliornia, Texas and Iowa each have more cars than has Great Britain.

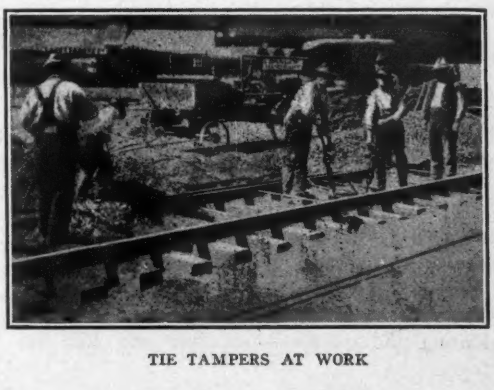


THE COMPRESSOR

HOME-MADE COMPRESSOR RIG. CHEAP TIE TAMPING

When the matter of using pneumatic tampers was brought to the attention of the San Francisco-Oakland Terminal Railways, the first cost was a prime consideration owing to the widespread need of retrenchment. It was happily suggested, however, that the cost of the compressor, say $500 or more, could be saved by using some old railway compressors.

The suggestion was carried out by mounting a battery of six 11-cu. ft. capacity pumps on a truck as shown in the illustration. The actual capacity required for the two Ingersoll-Rand tampers used is only 32 cu. ft., but double capacity was installed because the old machines were not good for continuous service at more than 50 per cent. loading. These tampers have proved particularly successful in tamping heavy special work. On this railway the machines have allowed six men to do the work which formerly required sixteen. Of the six men one is stationed to flag vehicles while another handles the connection to the trol-



TIE TAMPERS AT WORK

ley wire, leaving the remaining four to do the tamping.

With labor at $2.50 a day, the relative costs are: Air tamping, $15; hand tamping, $40—a saving of $25 a day. As a matter of fact the tampers paid for themselves within ten days. These tampers are also used for flat tamping of ballast in advance of concreting. They are fitted with chisels when wanted for clipping concrete and with cutters when used in stripping out asphalt.

A SHAFT-SINKING RECORD

Since the discovery of the United Verde Extension Mine the district about Jerome, Ariz., has received a great deal of attention from mining engineers and operators. Prospecting resolved itself first of all into a question of shaft sinking, and the development companies formed were organized on a basis permitting sinking a shaft to 1,200 or 1,400 ft. before crosscutting and drifting commences. Under these conditions it was natural to look for something pretty good in shaft-sinking records, and the Gadsden shaft is the first one to "draw blood."

The Gadsden is a development prospect of the Calumet & Arizona Mining Co. It is in the mineral belt about 1½ miles south and east of Jerome. The work is under the general direction of John C. Greenway, general manager of the Calumet & Arizona at Bisbee, and J. K. Hooper is the superintendent directly in charge. It was decided to open the property by a shaft to approximately the 1,000-ft. level before drifts were run.

The shaft is 5 ft. x 17 ft. 10 in. in the clear, divided into two hoisting compartments and a pipe and manway; 12x12-in. timbers are used, and the ground is broken about 8x21 ft. The surface plant consists of a 220-hp. direct-motion electric hoist, an 888-cu. ft. Imperial belt-driven compressor and full blacksmithing equipment, including a No. 5 Leyner sharpener.

By May 1 the work was well under way. A satisfactory bonus rate had been worked out by Mr. Hooper, and the men were instructed to go to it. For seven consecutive days the shaft went down nine feet a day, and no part of the work was allowed to drag. The shaft was close timbered, guides, ladderway, air and water pipes kept up each day. During the month some time was lost because of power trouble and the Jerome strike tied the work up several shifts; in spite of all this a grand total of 202 ft. was made for the month—a record which is now a mark for all the properties in the district.

The Gadsden shaft during the record month was in limestone, which varied from a fairly solid uniform drilling rock to a shattered fitchery ground. The regular shaft round was used, cut holes running from 10 to 12 ft. deep. Five Ingersoll Jackhamers with ⅞-in. hollow hexagon steel were used, and no difficulty was experienced in drilling the deep holes, steels being fitted with standard four-point bits. All holes were loaded with 40 per cent. and 60 per cent. gelatin powder, the 60 per cent. being placed in the bottom of the holes.

At the end of the month the shaft was in excellent condition, no detail having been slighted.—*Eng. and Min. Journal.*

SUCCESS OF THE DRILL WAGON

In the 1916 edition of Gillette's "Handbook of Rock Excavation," comment is made upon the growing tendency to use very large drills where the surface of the rock is comparatively level and the holes comparatively deep. A level surface permits mounting the drilling outfit on wheels, enabling the drill to be moved speedily from hole to hole.

It has not been regarded as economic to use large drills (with 5-in. cylinders, such as are designed for subaqueous drilling) in drilling shallow holes or where the surface of the rock is very irregular. But the recent economic success of such drills in deepening the channel of the Mississippi at Le Clair, Iowa, known as the Le Clair Canal, seems to warrant serious consideration of large drills even for shallow holes and where the rock surface is rough. This work involves making a rock cut nowhere more than 5 ft. deep, in an unusually "spongy" limestone full of holes and having an uneven surface. Air hammer drills (Jackhamers) were tried at first, but crumbling rock clogged the bits, even when water jets were used, to such an extent that they were abandoned.

The problem was solved by mounting two Ingersoll-Rand slab-back drills on a flat car. The mounting is somewhat similar to that on a drill boat. Each drill is mounted in a sort of pile-driver frame, so that it can be raised and lowered with a hoisting engine, and the

frame can be moved laterally along a runway, this being 30 ft. long for the two drills. The flat car that carries the drills, boilers, etc., travels on track sections, 10 ft. long, like a steam shovel. Each drill has averaged 110 ft. per 8-hour shift. A water jet was used to good advantage.

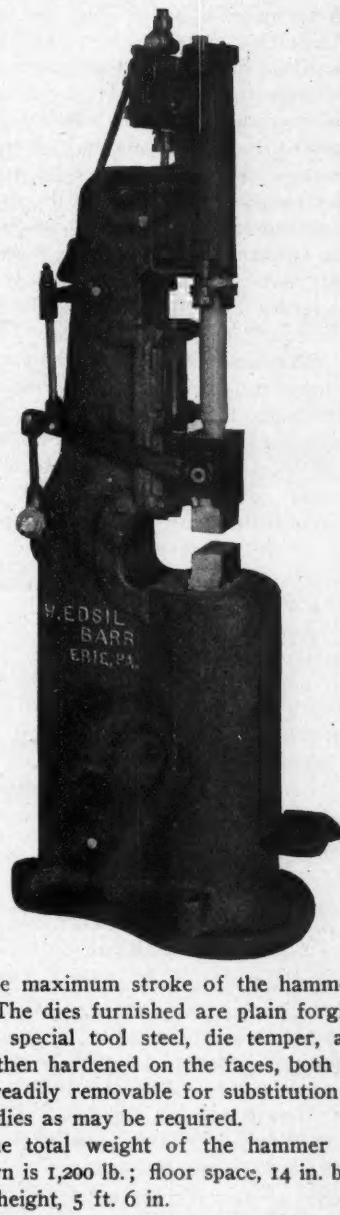
The solving of this problem of drilling economically in a very bad rock is highly creditable to the engineers in charge—Maj. G. M. Hoffman, Corps of Engineers, U. S. A., J. B. Bassett and H. E. Reeves, assistant engineers. The question that we now raise is whether a drill-car outfit of this kind is not adapted for shallow drilling even where the rock is sound. If 110 ft. per drill can be daily averaged under bad conditions, it is evident that considerably more can be averaged under ordinary conditions. Probably in solid rock and for shallow holes a smaller size of drill would serve, and in that case, it might be feasible to use runways longer than 30 ft., and perhaps provide a runway at each end of the drill car so that four or maybe six drills could work simultaneously.

IMPROVED PNEUMATIC HAMMER

The half tone shows the latest improved light pneumatic forging hammer built by H. Edsil Barr, Erie, Pa., the latest improvement comprising an automatic gear which permits continuous striking with a rapidity up to 200 blows a minute. Compressed air at the ordinary shop working pressure of 80 to 90 lb. gage is used, the speed and force of the blow being entirely under the control of the operator by means of a foot lever, leaving the hands free for manipulating the work.

In the design and construction of the hammer the aim has been to produce a strictly one man machine of maximum adaptability and of rugged and durable character. The valve gear requires no readjustment or attention in striking and reversing on any thickness up to 2 in., and the maximum speed and force of blow automatically results on the thicker material where the heaviest reduction and maximum effect in working the iron to the center is required.

Careful attention has been given to every detail both of material and workmanship, and the result is a thoroughly reliable machine as is evidenced by the numbers in use and the wide range of work.



The maximum stroke of the hammer is 10 in. The dies furnished are plain forging dies of a special tool steel, die temper, annealed and then hardened on the faces, both dies being readily removable for substitution of special dies as may be required.

The total weight of the hammer as here shown is 1,200 lb.; floor space, 14 in. by 24 in., and height, 5 ft. 6 in.

HAMMER DRILL RESENTS OVERPERSUASION

Every accident teaches a lesson, or should teach one; also, it occasionally happens that an accident very efficiently teaches a much-needed lesson, and at the same time comes within the "Purely Accidental" classification

of the State mine inspector. The case of Bernardo Ortiz belongs to the latter kind. Bernardo is a machine man in the mines of the Phelps Dodge Corporation, at Morenci, Ariz. Up until ten days ago, he believed in the time-honored method of pounding on the machine with a double-jack, piece of steel or any other handy weapon in case the machine refused to respond to his expert touch. But Bernardo is not now of that faith. Something happened that suddenly changed his mind. The occurrence was this: He was drilling in a raise with a B. C. 21 Ingersoll-Rand stopehamer. Essaying to change to a longer drill, he found that the steel was stuck in the chuck. As per custom, he seized the 6-lb. hammer lying by and plied same with vim. For was he not working on a contract? He brought the hammer down on the fronthead, which stood just a little above the man's waist. At the last stroke he gave the machine, however, a piece of steel about the size of a .22 caliber bullet flaked off the edge of the fronthead and entered the man's abdomen, perforating his large intestine and an artery. The doctor found the bullet in the neighborhood of the man's kidneys, and the patient is getting well. The State mine inspector is satisfied the accident was not the company's fault, and the operators are satisfied the Spaniard will not hammer the machine again.—*Eng. and Mining Journal.*

NOTES

The Ingersoll-Rand Company announces that, at a meeting of the Board of Directors of the Company, Mr. J. H. Jowett, formerly General Sales Manager, was elected Vice-President of the Company, and that Mr. L. D. Albin, formerly Assistant General Sales Manager, was appointed General Sales Manager. Mr. Jowett and Mr. Albin will continue to make the Company's New York office, at 11 Broadway, their headquarters.

The Du Ponts, of powder fame, are said to have on their payroll, 2,000 chemists, who, among other things, are conducting research work preparatory to giving Germany a "run for its money" in the production of dyes.

The city of Pernambuco, Brazil, is installing a new system of street numbering. The metric system is used. If for instance the number of a house is 134, then that particular house is 134 meters from a certain starting point. The house across the street would be 135 meters or the nearest number to the actual distance from the starting point. There is no telling what the metric craze may lead to.

At the cantonment near Atlanta, Ga., gas furnaces are to be installed for the production of a ton and a half of peanut brittle per day for the soldiers there.

There are 450 irrigation companies in California, and it is estimated that they will irrigate a million more acres in 1917 than in 1916.

It is believed that the driest place in the world is that portion of Egypt between the two lower falls of the Nile. Rain has never been known to fall there.

Fifty million barrels of fuel oil (50,000,000), or nearly three times the total production of crude petroleum in Southern Texas and Southern Louisiana during the entire year of 1916, according to Secretary Daniels, are to be ordered by the United States Government for the use of the navy alone.

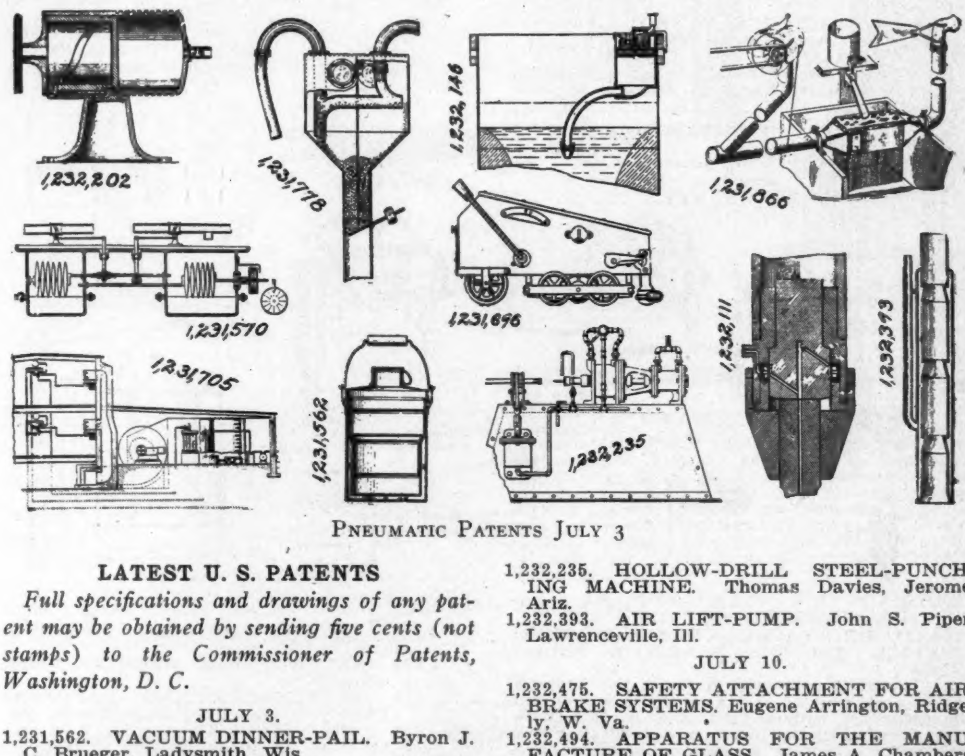
Argentina is developing oil-fields in Patagonia and in other parts of the republic. A recent report by the Argentine Bureau of Mines affirms that the petroleum deposits of Rivadavia on the Patagonian coast promise to rank among the most important of the world.

In June, 1914, aluminum sold for 17.5 cents per pound. During the war the price has gone up to 60 cents on account of its demonstrated value in the making of explosives. Mr. Arthur V. Davis, president of the Aluminum Company of America, has offered to supply the U. S. Government with all the aluminum it needs at 27.5 cents per pound.

The air in water is undoubtedly one of the causes of the rusting of water pipe. Mr. H. R. Holmes, an engineer of Pensacola, Fla., proved that an excessive amount of air in the water was the cause of an unusual rapidity of corrosion of pipes. The corrosion was so rapid that it had been attributed to elec-

trolysis, but Mr. Holmes not only showed that no appreciable electric currents existed but that the corrosion of the pipes was mostly on the inside and at the top where air bubbles were liberated. Water drawn from a faucet into a glass liberated bubbles of air in abundance.

Two ears of corn a year per acre were paid by the Lehigh Coal Co. in 1792 and following years for the lease of large areas of coal land. The bulk of the coal-bearing lands were patented by the State of Pennsylvania from 1795 to about 1816, the payments made by the grantees being $2 to $4 per acre. During the 40's and 50's of the last century $50 per acre was a good price, but by 1875 the value of the best land had risen to $500 an acre. This value rapidly increased until at the present time $3,000 per acre is considered only a fair price for good virgin coal land, and but little of this has come on the market for years.



PNEUMATIC PATENTS JULY 3

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JULY 3.

1,231,562. VACUUM DINNER-PAIL. Byron J. C. Brueger, Ladysmith, Wis.
1,211,570. REGULATOR FOR AIR-CONDITIONING APPARATUS. Stuart W. Cramer and William B. Hodge, Charlotte, N. C.
1,231,696. VACUUM-CLEANER OR COMBINED VACUUM-CLEANER AND CARPET-SWEEPER. Bernard John Bouwmeester, Grand Rapids, Mich.
1,231,705. APPARATUS FOR REGULATING THE HUMIDITY AND TEMPERATURE OF AIR. Willis H. Carrier, Buffalo, N. Y.
1,231,777. CUSHION PNEUMATIC HEEL. Oscar Mussinan, New York, N. Y.
1,231,778. PNEUMATIC GRAIN ELEVATOR AND SEPARATOR. Charles P. Nall, Minneapolis, Minn.
1,231,866. MILK-AERATOR. Michael Duvall, Lincoln, Wis.
1,232,111. ROCK-DRILL. Michael Smith, Bisbee, Ariz.
1,232,146. MANUFACTURE OF ICE. William P. Wiemann, Pittsburgh, Pa.
1,232,202. AIR-COMPRESSOR. Emmet J. Brown, Terre Haute, Ind.
1,232,235. HOLLOW-DRILL STEEL-PUNCHING MACHINE. Thomas Davies, Jerome, Ariz.
1,232,393. AIR LIFT-PUMP. John S. Piper, Lawrenceville, Ill.

JULY 10.

1,232,475. SAFETY ATTACHMENT FOR AIR-BRAKE SYSTEMS. Eugene Arrington, Ridgely, W. Va.
1,232,494. APPARATUS FOR THE MANUFACTURE OF GLASS. James A. Chambers, Pittsburgh, Pa.
1,232,506. APPARATUS FOR ATOMIZING HYDROCARBON FUELS. Anthony Costa, Cleveland, Ohio.
1,232,557. FLUID-CONTROLLING VALVE FOR GOVERNORS. Henry D. Johnson, Dumfries, Va.
1,232,585. PNEUMATIC HAMMER. Arthur J. McQuaide, Canton, Ohio.
1,232,618. SPRAYING OR ATOMIZING DEVICE. Walter J. Smart, New York, N. Y.
1,232,640. FEEDING AND BURNING FINE FUEL. Walter D. Wood, New York, N. Y. James W. Lynch, East St. Louis, Ill.
1,232,703. BOTTLE-BLOWING MACHINE. James W. Lynch, East St. Louis, Ill.
1,232,726. PNEUMATIC-TIRE-TUBE VALVE. Sidney C. Sladden, New York, N. Y.
1,232,787. FLUID-PRESS FOR RUBBER FOOTWEAR. John R. Gammeter, Akron, O.
1,232,797. FLUID-PRESSURE-CONTROLLED REVERSING-GEAR. Theodore A. Hedendahl, Denver, Colo.

1,233,177. VISCOSIMETER. Charles H. Briggs, Minneapolis, Minn.

1. A viscosimeter for measuring the rate of flow of material under a predetermined suction thereon, comprising a test tube having a free open end adapted to be placed against the material to be tested, means for producing a predetermined diminution of pressure in the test tube, whereby the material is drawn into the same, and a graduated scale associated with the test tube for measuring the viscosity of the material.

1,233,275. AIR-COMPRESSOR. Charles Volney Kerr, East Orange, N. J.

JULY 17.

1,233,336. PNEUMATIC PLAYER. Charles Freborg, Kankakee, Ill.

1,233,367. PNEUMATIC DEVICE FOR PLAYER-PIANOS. Otis M. Kennedy, Philadelphia, Pa.

1,233,408-9. VACUUM-CLEANER. John W. Shanahan, Grand Rapids, Mich.

1,233,410. MACHINE FOR CLEANING TOBACCO-PIPES AND THE LIKE. Frederick Hudson Shepherd Shepherd, London, England.

1. In valve construction, the combination of a flat annular valve of limited thickness, a valve-seat-forming member having an annular shoulder to form a seat for the valve at its inner edge, another annular seat-forming member having also a shoulder which is concentrically spaced from the shoulder first mentioned to form a port between them and constituting a seat for the valve near its outer edge, springs to hold the valve to these seats, a valve head provided with openings and means to attach the seat-forming members to this head.

1,233,696. FLY-CATCHER. Harry Pakeman, Columbus, Ohio.

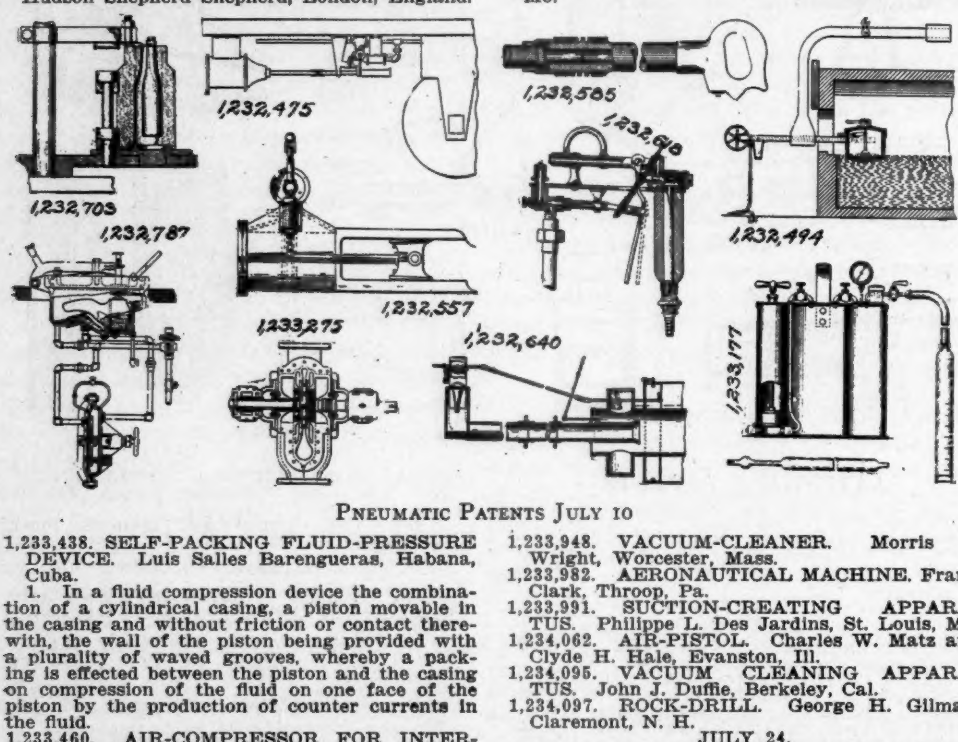
1,233,723. DRILL-SHARPENER. William A. Smith, Denver, Colo.

1,233,844. AIR-STRAINER FOR AIR-COMPRESSORS. Nelson T. Cline, Pittsburgh, Pa.

1,233,923. PNEUMATIC VALVE MECHANISM. Richard T. Schriber, Guss George, and William H. Meacham, Alton Park, Tenn.

1,233,928. HAND-CONTROLLED VACUUM-CLEANER. Howard Small, Wyncote, Pa.

1,233,944. AIR-GUN. Adolph Wissler, St. Louis, Mo.



PNEUMATIC PATENTS JULY 10

1,233,438. SELF-PACKING FLUID-PRESSURE DEVICE. Luis Salles Barengueras, Habana, Cuba.

1. In a fluid compression device the combination of a cylindrical casing, a piston movable in the casing and without friction or contact therewith, the wall of the piston being provided with a plurality of waved grooves, whereby a packing is effected between the piston and the casing on compression of the fluid on one face of the piston by the production of counter currents in the fluid.

1,233,460. AIR-COMPRESSOR FOR INTERNAL-COMBUSTION ENGINES. Guido Fornaca, Turin, Italy.

1,233,555. APPARATUS FOR CLEANING AND HEATING AIR. William F. Cox, Danville, Va.

1,233,581. ROTARY COMPRESSOR OR EXHAUSTER. John Johnston, London, England.

1,233,594. AIR-PRESSURE - LIMITING DEVICE. James H. Mitchell, Denver, Colo.

1,233,668. MILKING-MACHINE. Arthur V. Hinman, Oneida, N. Y.

1. In a milking machine, a power-driven individual vacuum pump, a vacuum pail connected to be exhausted thereby, teat cups, and means for producing pulsations in the cups by the movement of the pump piston, whereby the milk is drawn from the cow into the pail.

1,233,693. COMPRESSOR. Edwin M. Niebling, Cincinnati, Ohio.

1,233,948. VACUUM-CLEANER. Morris S. Wright, Worcester, Mass.

1,233,982. AERONAUTICAL MACHINE. Frank Clark, Throop, Pa.

1,233,991. SUCTION-CREATING APPARATUS. Philippe L. Des Jardins, St. Louis, Mo.

1,234,062. AIR-PISTOL. Charles W. Matz and Clyde H. Hale, Evanston, Ill.

1,234,095. VACUUM CLEANING APPARATUS. John J. Duffie, Berkeley, Cal.

1,234,097. ROCK-DRILL. George H. Gilman, Claremont, N. H.

JULY 24.

1,234,130. ELECTRICALLY - DRIVEN TIRE-INFLATING PUMP. Benjamin S. Cartwright, Oelrichs, S. D.

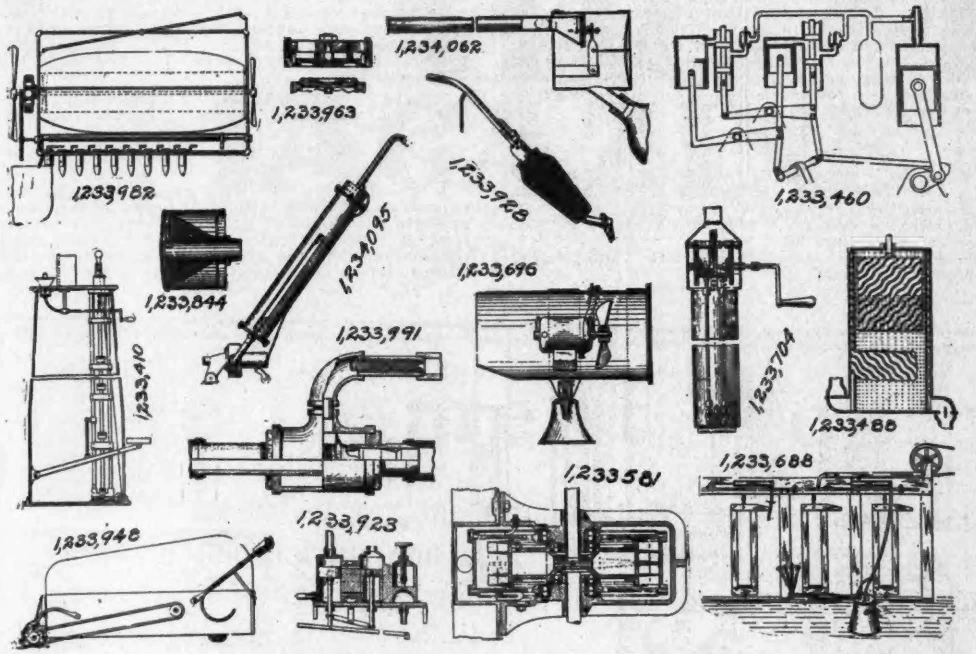
1,234,214. INSECT - ERADICATOR. Mercer Reynolds, St. Elmo, Tenn.

An insect eradicator comprising a complete circuit for air with means for forcing the air through the circuit, means for drying the air, means for heating the same, conveyer means in the circuit for the passage of the material to be treated and means for filtering the air on its passage to the air forcing means.

1,234,281. PNEUMATIC CONVEYER. Charles H. Burton, Washington, D. C.

1,234,378. AIR-BRUSH. Charles H. Parkin, Cleveland, Ohio.

1,234,446. PORTABLE BLOWER. Horace E. Clark, Kirkwood, Ga.



PNEUMATIC PATENTS JULY 17

1,234,505. GAS-VOLUME STANDARD FOR TESTING VOLUME - MEASURING APPARATUS FOR GAS. Marcus H. Stillman, Washington, D. C.

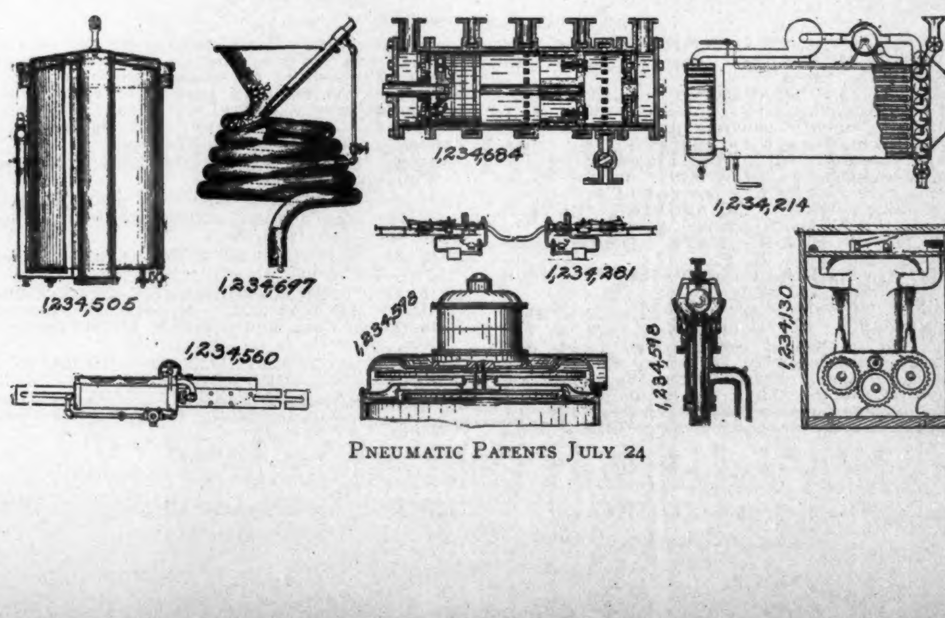
1,234,560. PNEUMATIC MOTOR FOR FLUE-CUTTERS. Harvey D. Palmer, Topeka, Kans.

1,234,598. SUCTION-MACHINE. John Wynn, Jr., Canton, Ohio.

1,234,684. COMPRESSION-PUMP. Edwin M. Niebling, Cincinnati, Ohio.

1. In a compressor, the combination of a cylinder, valve-controlled gas-outlets in each of its ends, pistons coupled together with a space between them, reciprocating between these ends, a central inlet midway between the ends of the cylinder to admit gas at low pressure to the cylinder-space between the pistons, an additional inlet between this central inlet and each end of the cylinder to admit gas at high pressure into each of the spaces between each end of the cylinder outside of each piston, openings in each piston to permit gas from the space between the pistons to pass into the spaces outside of them and between them and the ends of the cylinder and spring-actuated valves to control these openings.

1,234,697-8. APPARATUS FOR REMOVING STEMS FROM FRESH FRUIT. John B. Foote, Oak Park, Ill.



PNEUMATIC PATENTS JULY 24

1. Apparatus for stemming fruit comprising a runway having a substantially smooth surface on which the fruit is free to roll and which, when struck by the stems of the fruit will sever them, the runway being formed so the fruit will roll without being crushed, and fluid means under pressure for propelling the fruit through the runway.

JULY 31.

1,234,850. COMBINED VACUUM - CLEANER AND BLOWER. Ernest L. B. Zimmer, Oakland, Cal.

1,234,908. VALVED AIR-PUMP. Jesse E. Keppel, St. Louis, Mo.

1,234,935. SAUSAGE-STUFFER. John M. Peterson, Chicago, Ill.

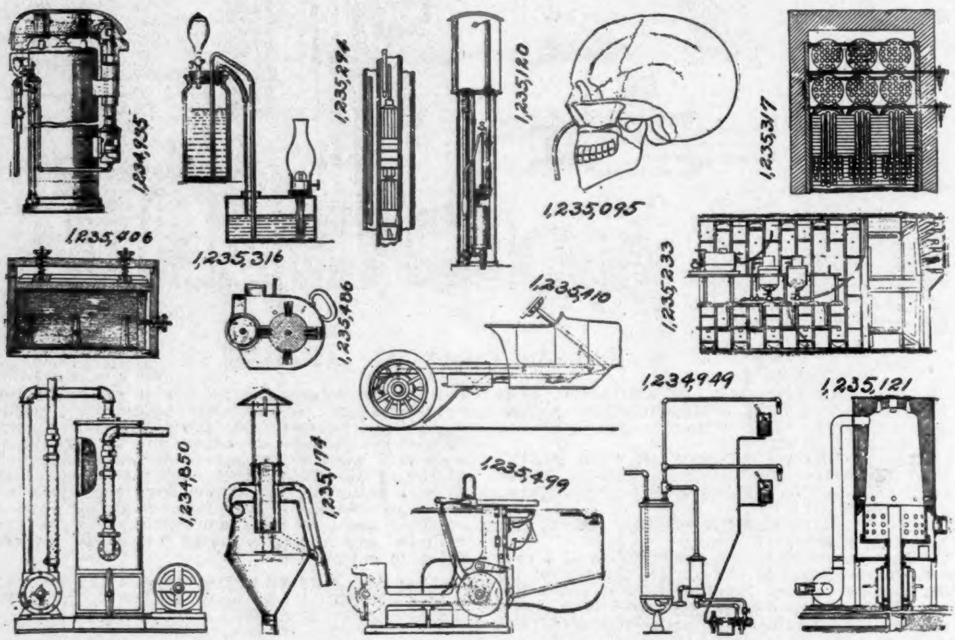
behind the tail of the shield against the lining and the wall of the boring, compacting said material to at once support the surrounding ground.

1,235,294. APPARATUS FOR CLEANING DEEP WELLS. George W. Deats, Forth Worth, Tex.

1,235,316. AUTOMATIC SIPHON-REGULATOR. Charles H. Henderson, Port Orchard, Wash.

1,235,317. BOILER-TUBE CLEANER. Samuel J. Herman, Detroit, Mich.

1. The combination with groups of tubes arranged in adjacent rows with baffle plates intermediate the adjacent groups at one side of the row, of a blower tube extending between rows transversely of said groups and parallel to said baffles, jet nozzles upon opposite sides of said



PNEUMATIC PATENTS JULY 31

1,234,949. REMOTE CONTROL MEANS FOR WATER-HEATERS. Elmer S. Stack, West Somerville, Mass.

1,235,095. INFLATABLE SURGICAL PACKING. Augustus L. Beck, New Rochelle, N. Y.

1. A pneumatic packing for the purpose described comprising a closed flexible bag whose shape is conformed to the nasal chamber and having comparatively resistant ends, and an inflating tube leading into one end of said bag.

1,235,120. LIQUID - MEASURING DEVICE. Frederick William Delanoy, Alameda, Cal.

1,235,121. FURNACE-GRATE. Henry L. Doherty, New York, N. Y.

1,235,174. PNEUMATIC SEPARATOR. Milton F. Williams, St. Louis, Mo.

1,235,233. METHOD OF TUNNEL CONSTRUCTION. John F. O'Rourke, New York, N. Y.

5. The method of constructing tunnels consisting in making a tunnel boring for a shield, erecting a tunnel lining within the tail of the shield, advancing the shield along said lining, and blowing a current of air carrying loose solid material into the space outside of the lining

blower tube dissimilarly distributed, the nozzles on one side covering the area of each entire group of tubes and the nozzles on the opposite side being limited to a portion of each group and avoiding the baffles, and means for rotatively adjusting said blower tube limited to a partial revolution thereof.

1,235,406. PNEUMATIC FEEDER. Samuel Williams, Elk City, Okla.

1,235,410. SANDING DEVICE FOR VEHICLES. Henry Adam Alheit and John Anton Boyken, New York, N. Y.

1,235,486. COTTON - PICKER. Oscar D. Killebrew, Richmond, Va.

1,235,499. PNEUMATIC BLANK-TRANSFERRING MECHANISM. Melville E. Peters, George H. Fath, and Albert F. Miller, Denver, Colo.

1,235,500. AUTOMATICALLY - OPERATING BLANK OR LABEL FEEDING MECHANISM FOR BLANK-GUMMING MACHINES. Melville E. Peters, George H. Fath, and Albert F. Miller, Denver, Colo.